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EDITORIAL ANNOUNCEMENTS.

THE BRITISH AND EASTERN CONTINENTS
edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name *Railway Gazette*.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information

of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

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CONTENTS

EDITORIAL:

New York Transportation.....	345
President Stickney on Rate Regulation.....	345
Electric Railways in New England.....	345
Electric Railway Accounts.....	346
The Progress of Rate Regulation.....	346
Prizes for Improved Railroad Appliances.....	347
Trade Catalogues.....	347
ILLUSTRATED:	
The Pennsylvania Railroad's Extension to New York and Long Island.....	349
Charging Storage Batteries from Alternating Current Circuits: The Mercury Arc Rectifier.....	352
Map of New York Freight Terminals.....	354
The New Bergen Hill Tunnel of the Lackawanna.....	356

Test of the Sauvage Air Brake.....	359
A Reinforced Concrete Elevated Roadway.....	364
The McCord Draft Gear.....	367
A New Design of Metal Saw.....	368
CONTRIBUTIONS:	
Approach and Detector Locking.....	347
Filing Right of Way Records.....	348
The Operator and the Adobe Collision.....	348
MISCELLANEOUS:	
Railway Signal Association.....	348
Michigan Railroad Tax Law Upheld.....	353
National Association of Railway Commissioners.....	354
Washington Correspondence.....	354
Passes on Italian Railroads (Note).....	356
President Stickney on Rate Regulation.....	358

Railroad Decisions in March.....	363
Foreign Railroad Notes:	
The Simplon Express.....	364
Russian Rolling Stock.....	365
Machine Shop Practice.....	365
Professor Hutton's Resignation.....	368
Passenger Earnings on Baden Railroads (Note).....	368
GENERAL NEWS SECTION:	
Notes.....	101
Meetings and Announcements.....	104
Elections and Appointments.....	104
Locomotive Building.....	104
Car Building.....	104
Bridge Building.....	105
Railroad Construction.....	105
Railroad Corporation News.....	108

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FRIDAY, APRIL 6, 1906.

The statistics of passenger traffic in great cities are a never-falling source of wonder. As soon as we get accustomed to the hugeness of one set of figures we are presented with a new lot, which so far surpass any previous statement that we lose the basis of comparison by which we gage the size of things. The New York railroad commissioners have just issued a pamphlet of statistics of transportation in New York City, and this pamphlet shows that in the year 1905 in the five boroughs of Manhattan, Brooklyn, Bronx, Queens and Richmond, constituting Greater New York, there were 1,171,151,698 fares paid, an increase of something like 100,000,000 over the year previous. Now, according to *Poor's Manual*, all the steam railroads in the United States in the year 1904 carried 716,244,858 passengers; therefore, it appears that within the limits of Greater New York in the year 1905, 454,906,840 passengers more were carried than were carried in the previous year over all the ramifications of our steam railroads from Maine to California, and from the Canadian frontier to the Gulf of Mexico. But the passenger train mileage of the United States in 1904 was 444,156,014. The car mileage in Greater New York in 1905 was 230,249,455. To get the full dramatic value out of these figures, we must add to the paid fares the number of transfers, since a transfer means a ride just as much as a paid fare does and has the same effect in congesting traffic. If, therefore, we add transfers and paid fares, and divide by the car mileage, we find that throughout the railroads of the country in 1904 there was an average of 1.6 passengers per train-mile, while on the Greater New York transportation system there was an average of 6.2 passengers per single car-mile.

In the early stages of the rate regulation controversy Mr. A. B. Stickney, President of the Chicago Great Western, was looked upon as somewhat of a radical because he advocated the enactment of legislation that would really regulate rates, instead of saying, with most critics of the Esch-Townsend bill, that effective regulation was impossible. In a very excellent paper, published in the *Political Science Quarterly*, part of which we print this week, Mr. Stickney maintains his position in a very able way. He also shows with great clearness the nature of the task that is comprised in attempting to formulate legislation that will be of any conceivable use. He says, most happily, that it is a distinguishing characteristic of the American mind that it seeks to remedy every economic evil by passing a law. The average mind regards the enactment of the law as sufficient. The average mind is always in favor of enacting a law, but after the law is enacted the average mind is opposed to its en-

forcement; and when such a law has been enacted and no attempt has been made to enforce it and the evil continues to exist, the demand of the average mind is not to enforce the existing law but to enact a new law. This is a keen sighted exposition of a trait of the American character that is prominently in the foreground at the present time. Mr. Stickney expressed the same point graphically just about a year ago, when he called attention to the fact that the law which makes it a misdemeanor for any individual not an officer of a railroad company to use a pass was enacted by Congress and approved by the President fifteen years ago, while, as an individual rule of action, it was ignored by the Congressmen who passed it and by the President who approved it. What, then, is Mr. Stickney's remedy? He mentions, in passing, that if there are such things as reasonable rates they must be based on something, and that nobody knows what they must be based on; while, if Congress confines itself to enacting laws which declare, like the present law, that all rates shall be reasonable and just, it is simply enacting a moral rule which no one will dispute and which no one can interpret or apply. Mr. Stickney suggests that before the enactment of any legislation Congress provide an interstate commerce investigation committee, on which there shall be a sound lawyer, a mathematician, a railroad auditor, an engineer, a superintendent, a traffic manager and a station agent. He is disposed to believe that this body of men will find that net rates—the remainder of the rates after deduction of the rebates—are the reasonable and just rates which should constitute the tariff. How hopeless the present situation is from the standpoint of the possibility of actually accomplishing anything good or useful Mr. Stickney clearly concedes when he says that after, but not before, a thorough investigation by such a committee it would seem possible to frame legislation which would be just, intelligible and enforceable. As there is not the slightest possibility that Mr. Stickney's suggestion will be carried out, the chance of a useful law must seem remote to him, as it does to us.

During the last two or three months, in the steam-trolley annals of New England, history or, at least, the outline of history, has been making itself at an exceptional pace. The Boston & Maine, already with power to acquire electric lines in New Hampshire, is still seeking like privilege in Massachusetts and seems pretty sure, ere long, to get it. This will be probably the prelude to belated fulfilment in upper New England and Massachusetts of a plan that copies the largely accomplished work of President Mellen in Connecticut and southern and central Massachusetts. While

minor in dimension, the Boston & Maine policy promises to be almost exactly similar in conditions and character to the Mellen idea. But the inchoate situation in upper New England dwarfs in meaning when compared with present elements of the New Haven policy and its results now and prospective. There seems to be little doubt that the highly absorbent corporation has acquired the whole street railway system of Worcester; while only a final agreement as to the price of much watered stocks bars the way to purchase of the 170 miles or more of track of the Connecticut Railway & Lighting Company. These two purchases would carry the New Haven's street railway mileage well up toward the thousand mile mark. It would create several interesting new situations among which one is worth special attention: The New Haven would then be anchored firmly by purchased street railway systems at three points of population in Massachusetts—Pittsfield in the west, Springfield at the center and Worcester in the east. All three of these are on the Boston & Albany steam line already paralleled by a long distance electric road between Worcester and Boston; and acquired electric lines of the New Haven already span a considerable part of the distance between Worcester and Springfield. What such a system imports, only the future can tell; but, as a guess, the immediate policy of the New Haven is self-protective rather than aggressive and may be described metaphorically, as that of the sheathed club. Meanwhile two more general facts deserve sharp attention: First, how the non-protective and ultra-conservative policy of the Boston & Albany in refusing during its long life to acquire steam lines has been repeated in the case of electrics, in spite of the different policy of the lessee corporation, the New York Central, in New York state. And, secondly, bulks very big the more striking fact that in the very important, if not extensive, railroad region represented by the New England the knell has been sounded of steam railroad extension for almost every railroad purpose—whether competition, protection or business in new territory. For policies, plans and combinations based on the precedents of steam railroad operation and development there is now substituted in that region a policy based on electricity. How long will it be before we find a similar condition of railroad affairs in other and much greater areas of the country, especially those of dense population?

ELECTRIC RAILWAY ACCOUNTS.

A handbook, recently issued, deals with the subject of electric railway accounting, taking into consideration the monthly report of a street railway company, the annual report and the general work of the accounting department.*

It seems worth while to devote special attention to this book because of the lamentable lack of fullness, of clearness and of uniformity of practice in the reports which are sent out by the street railway companies throughout the country. The diversity of these reports is so great that nothing like the same estimate of the properties involved can be obtained that can be gotten from the reports of the steam railroad companies, harmonized and unified under the wise guidance of the Interstate Commerce Commission. The author of the present book does not go into his subject very deeply from the standpoint of the investor or of the student of transportation. He is an accountant, and he is chiefly concerned in having certain things brought out properly and clearly in the statements which the companies make. Thus, he is concerned that the monthly reports should be issued promptly; that companies should adopt a uniform style of making these statements, and that the work should be done in an honest and thorough manner. In all this we heartily concur, as also in the objections which he raises to dependence on the operating ratio, so called; the ratio of operating expenses to gross earnings, as a measure of the efficiency or economy of a property. As Mr. Brockway points out, this ratio is affected by a great many things which the ratio itself does not disclose. He cites a case in a city where two companies compete practically throughout. Assuming that each gets half the business and has to run full service to do it, it follows that the percentage of expenses to earnings is very high with each company, as each has expense enough for all the business, although it gets but half of it. This high ratio is not the fault of physical conditions in this case, and is certainly not a figure by which the efficiency of the management can be tested. As the author also points out, if the bonded indebtedness is large (as it is very apt to be with

*Electric Railway Accounting, by W. B. Brockway, General Accountant Nashville Railway & Light Company, and ex-Secretary Street Railway Accountants' Association of America. McGraw Publishing Co., New York, 1906. Price, \$1.25.

street railway lines), the fixed charges may absorb all that is gained by low operating cost, and therefore it is quite possible for a company to operate for 50 per cent. of its earnings and still not pay dividends to its stockholders.

Looking at the subject of street railway accounts from a standpoint perhaps rather broader, it has always seemed to us most unfortunate that the expense statement is quite habitually lumped, and not separated into its component parts. The man unacquainted with a particular property who tries to derive some knowledge of it from the company's report would doubtless hold that this division of expenses is just about as important an item as the statement of expenses itself. Under the present customary way of presenting street railway reports, we know what the gross earnings are and we can rely upon that figure, and we also know what the operating expenses are and what is left for payment of fixed charges and for distribution to stockholders; but we cannot possibly tell whether the net earnings stated have been obtained by starving the property, or whether track, rolling stock and power plant have been liberally maintained out of earnings. We can only suspect, because of many sorrowful experiences in the past, that a company is likely to be insufficiently maintaining itself out of earnings if we happen to know that it needs new capital and is particularly anxious to make a good showing. Therefore, the mere fact of this omission of detail in the expense account throws almost every company under suspicion at one time or another in its corporate history. The information about what a company ought to spend for maintenance of way and structures and for maintenance of power house and equipment is actually so scarce that a single company might give these details with all fullness and find that they conveyed very little meaning to its critics because of the lack of a standard of comparison.

The best street railway report which has come to our attention is that of the Twin City Rapid Transit Co., of St. Paul and Minneapolis. The income account of this company, for the year ending June 30, 1905, is shown as follows:

	Receipts.
Passenger earnings	\$4,733,335
Miscellaneous earnings	25,928
Total earnings	<hr/> \$4,759,263
<i>Expenses.</i>	
Maintenance of way and structures	\$143,491
Maintenance of equipment	203,762
Operation of power plant	403,574
Car service	945,784
General expenses	228,585
Legal expenses	22,999
Injuries and damages	122,948
Insurance	26,605
Insurance Fund	21,395
Total operating expenses	<hr/> \$2,119,145
Net earnings from operation	2,640,117
Interest and taxes	1,050,797
Surplus available for dividends	1,589,320
Preferred dividends	\$210,000
Common dividends	881,387
Total dividends	<hr/> 1,691,387
Balance, after dividends	497,933
Appropriated for renewals	240,000
Front, forward	257,933

This statement is printed in full as an example of what street railway accounts ought to be—and are not! The Twin City report is not only favorable; it is also honest, and it seems to us most desirable that all street railway accounting should not only be honest and thorough as far as it goes, as the author of the present book recommends, but also that it should embrace with frankness this truly critical matter of the expense account, and thereby take pleasure in showing all the world when it has nothing to conceal.

THE PROGRESS OF RATE REGULATION.

Rate regulation by government may be said to have been a potential possibility since early in President Roosevelt's first term. The passage of a specific law has been directly imminent since the President's message at the close of 1904, and the hasty introduction of the Esch-Townsend bill into the House December 5, and into the Senate December 6, 1904. Two other dates—really three other dates—stand prominent in the history of the efforts which are being made to give Congress direct authority over railroad rates. It was on March 2, 1905, that the Committee on Interstate Commerce, by resolution of Senator Kean, was authorized to take testimony on the subject, and started its efforts, resulting in the publication of a five-volume report. The Hepburn bill, embodying what has been assumed to be the Administration's position and eliminating some, though not all, of the crudities of the original measure, was introduced in the House of Representatives January 24, 1906, and

was passed by the House with but little demur. The last date to be kept in mind is February 23, 1906. After the crude and unconsidered action by the House the Hepburn bill had a narrow escape in the Senate Committee, where Senators Aldrich, Elkins, Foraker and others failed by one vote to bury it. Then, by a sudden turn, which puzzled many beholders and edified all, they put Senator Tillman, a Democrat, hostile to the Administration, vengeful, distrustful of President Roosevelt personally and politically, and most wont to execrate his Southern policy, in charge. Thus it is six weeks to-day since the Hepburn bill emerged from committee under the most unique circumstances as a Democratic measure, in charge of the Senator who hates the President as the devil hates holy water.

Since February 23 the history of the rate regulation bill has been marked by some of the best debate that has ever been brought out in the Senate of the United States. The traditional obstructionism of that body has given way to an earnest and sober discussion, with speeches of great brilliancy by Senators Foraker, Lodge, Knox, and others. The opponents of the bill take their ground that it is unconstitutional. Its friends hold to the contrary.

During the last few weeks the special point of debate has narrowed down very much from the earlier discursive attacks and rejoinders. Many of the attacks had been aimed at side issues, and many of the rejoinders had shown no obvious connection with the attacks. The Hepburn bill provides in its amendment to Section 15 of the Act to Regulate Commerce, lines five to nine on page 11, that orders of the Commission shall go into effect thirty days after notice to the carrier, and shall remain in force and be observed by the carrier unless the same shall be suspended or modified or set aside by the Commission, or be suspended or set aside by a court of competent jurisdiction. It provides in its amendment to Section 16 of the Act to Regulate Commerce, page 17, lines four to nine, that from any action upon petition a bill shall lie by either party to the Supreme Court of the United States, and in such court the case shall have priority in hearing and termination over all other causes except criminal causes; *but such appeal shall not vacate or suspend the order appealed from.* The italics are ours. And in these 12 words lie the crux of the situation. There are now two parties in the Senate; the party of broad review, and the party of limited review by the courts. President Roosevelt long stood firm in his determination that no other provision for court review should be placed in the Hepburn bill than that already quoted, but on March 31, to the surprise of all and to the consternation of many, he changed this position and gave out an amendment indorsed by Attorney-General Moody and the radical Republican Senators, providing that the orders of the Interstate Commerce Commission may be suspended or set aside in a suit brought against the Commission in the circuit court of the United States sitting in equity.

Prior to this amendment, the stock answer of those opposed to tampering with the bill was that if the courts could not be prevented from exercising their normal functions, no provision could be made for such exercise further than that already stated. Against this it was contended that the courts could only work in the fields assigned them, and that if they were not given freedom of review they would simply declare the bill unconstitutional, and that would be the end of it. Greatest of all difficulties has been the question whether a judge should have power to suspend a litigated railroad rate pending final adjudication.

Here, then, is the issue. Shall the court be given full power of review for the fear that if not given it it will decline to uphold the bill as being plainly unconstitutional; and, if it is given this power, are we not again unconstitutional in vesting a judicial body with legislative powers?

This doubt that the courts can do any useful reviewing without transgressing their functions has never been more sharply accentuated by the decision by Mr. Justice Brewer, of the United States Supreme Court handed down April 2, upholding the Michigan tax law, primarily because it was not shown that the state had attempted to vest an administrative body with legislative functions, as claimed. Together with this decision, the justice included a most lucid and direct declaration that in the Nation no one of the three great departments can assume or be given the functions of another, for the constitution distinctly grants to the President, Congress and the judiciary separately the executive, legislative and judicial powers of the Nation.

But Justice Brewer went further than this expression of doubt that a judicial body could become legislative. He added, "It may therefore be conceded that an attempted delegation by Congress to the President or any ministerial officer or board of power to fix a

rate of taxation or exercise other legislative function would be judged unconstitutional."

In brief, the present situation is that nineteen senators, including such leaders as Spooner, Hale, Lodge, Kean, Knox and Lodge are put down to vote flatly against the Hepburn bill and any amendment that falls short of an absolute court review. Twenty-nine Republican senators are counted in favor of the President's amendment. It is certain that the Hepburn bill cannot be passed without specific provision for court review, and the observer is compelled to feel that the chances of passing any kind of a rate regulation bill that will be constitutional in its important provisions are extraordinarily small. We have already taken occasion to point out some of these points and to ask whether the Hepburn bill need be feared. We may add our full belief that it need not be.

The German Railroad Union offers every four years prizes for improvements in railroad appliances and methods. This year 7,500 marks are offered as first prize, 3,000 as second and 1,500 as third for inventions and improvements affecting the construction and maintenance of the railroads, the same for those affecting rolling stock; and a first prize of 3,000 marks and two prizes of 1,500 marks each for improvements in administrative methods, operation and statistics and for publications of notable value. The Union suggests some of the subjects which are felt to need improvement, though the prizes will not be confined to these. Among these suggestions are: Mechanical apparatus for firing locomotives; improvement of steam car-heating apparatus, especially for long trains; hose coupling for air-brakes, in which cut-off cocks may be dispensed with, without affecting the automatic working when trains break in two; apparatus for communication between trainmen and the locomotive, especially for long passenger and freight trains without continuous brakes, and also in passing through tunnels; a critical consideration of the present condition of the motor-car question, and of the running of light trains either by motor-cars or locomotives; simplification of the methods of dividing receipts from freight passing over more than one line, and of other freight accounting. The objects competing must have been put into use (or the writings published) between July 16, 1901, and July 15, 1907. Any such improvement must be in use on some railroad of the Union and be approved by such railroad. The applications for competition must be made between January 1 and July 15, 1907.

TRADE CATALOGUES.

Special Paints.—The National Paint Works, New York, is distributing its new blue book, being the sixth edition, entitled "Technical Review of Paints for Metal." It contains a number of comprehensive articles on paints for special purposes, such as station and railroad paints, structural iron paints, etc. About three pages are also devoted to an interesting discussion on the painting of steel cars.

CONTRIBUTIONS

Approach and Detector Locking.

Omaha, Neb., March 30, 1906.

TO THE EDITOR OF THE RAILROAD GAZETTE:

There is a certain system of electric route locking used in connection principally with electric interlocking plants, which seems to me to possess some rather objectionable features. In this system the indication circuits of the home signals are normally broken through open back points of indicator relays, controlled by the home track circuits, so that the signal lever cannot be put normal without forcing the indication or using a hand release unless a train happens to be occupying the track section. In other words, if the signalman clears a home signal he cannot restore his lever in the usual way unless a train is within the interlocking limits on the track governed. The approach locking is accomplished by breaking the power circuits of the switches, in the route governed, through points of a stick relay, whose circuit is controlled by a circuit breaker on the distant signal lever in parallel with the front point of an indicator relay controlled by the distant circuit.

I suppose the reason for this arrangement was to prevent the signalman from changing the route immediately in front of an approaching train by sticking his signal indication. To my mind, this system has the following defects:

1. It is impossible to test signals easily.
2. It interferes with flexibility of operation.
3. To make the plant absolutely safe, it is necessary to provide not only detector locking by breaking the power circuits of the

switches in a certain route through a relay, but also to break those of conflicting routes, which introduces undue complication in the wiring.

4. It leads signalmen into the habit of forcing their indications, as it is easier and quicker than to operate a hand release.

Having these points in mind when called upon to design the electric locking for a large and important plant recently, I devised the following scheme, which I wish to submit for criticism to the readers of the *Railroad Gazette*. Indicator relays are provided, controlled by track circuits in the usual manner. The indication circuit for each high home signal is broken through a front point of the indicator relay controlled by the track circuit in the route governed. With this arrangement signals can be cleared and the levers put normal at any time, provided a train is *not* in the section governed. The power circuits for all switches are broken through relays controlled by the indicator relays of their own sections, thus providing straight detector locking as an additional precaution. The approach locking is accomplished by breaking the indicator circuit of the home signal governing a certain route through the front points of a stick relay controlled by a circuit breaker on the distant signal lever in parallel with a front point on the distant indicator relay. The stick relay is restored as soon as a train has passed out of the home circuit. The result is that if a train passes the distant signal clear the indication circuit of the home signal is broken, until it has passed out of the home circuit. But if the distant signal is not clear, the electric locking does not operate until the train passes the home signal. In this plant it is proposed to cover up the home signal indication magnets so that they cannot be forced unless the signalman should crawl under the machine, a procedure which would consume as much time as the operation of a hand release and be much more difficult. The hand releases are arranged so that the first turn will break the circuit of the relays controlling the switches in a route, and the last will shunt out the points of the indicator relay controlling the signal indication.

W. H. ARKENBURGH,

Chief Draftsman, Signal Department, Union Pacific.

Filing Right of Way Records

Roanoke, Va., March 28th, 1906.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Thinking that my method of filing right-of-way records might prove interesting to some of your readers who are engaged in purchasing railroad right of way, I give you below a brief sketch of the same. This system of keeping these records is what I call the envelope system. While this system is not new for keeping lease records, and possibly other records as well, yet I am not aware that it has ever been used before in filing right of way records.

In buying right of way, of course, individual maps are made for each piece of property desired, and before the deed is obtained and the matter closed considerable correspondence is generally necessary. For instance, in dealings with the right of way agent, attorneys, land owners, company officials and others, this correspondence becomes quite voluminous. Our method of handling the records of each individual piece of property is to have the plan, all correspondence sent and received, copy of voucher bills, etc., contained in an envelope about 9½ in. by 15 in., with the following record printed on the same, which gives a complete history of the essential facts connected with any individual piece of property; in other words, it is a combination of the envelope and card systems:

7206		LOW GRADE LINE	CONCORD N. & W. RY.	7206
CONCORD TO FOREST, BRANCH				
Plan, No. 7206. Date: Feb. 4th, 1906.				
Sta. 448 + 63 to Sta. 460 + 85.				
Name: JOHN JONES.				
State: Virginia.				
County: Campbell. City: Lynchburg.				
Cost: \$1,000.00				
Acres: 7 7/8				
Option: March 14th, 1906—6 mo.—\$1,000.00				
Option Accepted: March 21st, 1906.				
Price per Acre: \$128.00				
Voucherized: March 29th, 1906.				
JOHN JONES.				
A 7 7/8				
21.				

I believe that the above record is self explanatory, with the exception of the figure 21 in the lower right-hand corner. This number has reference to the numerical number of that particular piece of right of way acquired on each piece or line of work, when more than one piece of right of way is purchased.

The advantages of this system are obvious to those who handle right of way records.

First.—During the negotiations for the purchase of right of way all the correspondence and facts in relation to the same are at

your instant command without searching through letter files, plan racks, voucher books, etc.

Second.—After the purchase of any piece of land is fully consummated and deed secured, the envelope can be filed away and given a permanent file number if desired.

I have used this system to great advantage since, by its use, delays, misplacing of correspondence, etc., never occur. This seemingly unimportant and insignificant system (like the card system) of keeping right of way records is only fully appreciated, and its true value only becomes known by its use. Therefore I gladly submit it to those who may find it an improvement on their own methods of filing right of way records with the sincere hope that they may get the same absolute satisfaction from the use of the same that we have obtained.

THEODORE LOW,
Real Estate Agent, Norfolk & Western.

The Operator and the Adobe Collision.

TO THE EDITOR OF THE RAILROAD GAZETTE:

"The case is one more disheartening instance of a man who knows his duty, but lacks the moral courage to do it when doing it may involve a little censure. Rather than admit having been asleep, and by such admission risking the loss of a dollar, this operator risked—and lost—a score of lives."

After perusing the editorial in the *Railroad Gazette* of March 23, of which the above is a part, the casual reader would be led to believe that this operator who slept while No. 3 passed Swallows was a moral derelict who deliberately made himself comfortable, took a good nap and upon awakening was so criminally indifferent to his responsibilities that he told the dispatcher that No. 3 had not passed when he knew that there was a possibility if not a probability that it had passed while he was asleep. Thus far there has been no evidence to show that this operator's previous record was not good. Until such evidence is forthcoming it would seem that he should be entitled to a little more charity. There is no one who realizes the awful responsibility which is upon him more than the operator himself—if he is old enough and has had the experience which one in such a position should have. Anyone who has experienced the terrible feeling which a railroad man has (though it be but for an instant) when he erroneously believes he has made a terrible mistake, will never take any chances which might make that state of mind permanent. The shock to the nervous system is something awful and indescribable. It is no wonder that some of the best of railroad employees have become violently insane soon after making such a mistake. An old conductor once said: "A man suffers the tortures of a thousand deaths in trying to keep awake while doubling the road at night." This operator was "doubling" at the time of this wreck. Any operator who has ever done this at night will tell you that it is quite possible for one to go to sleep sitting bolt upright at his sounder, sleep several minutes and awaken again without realizing that he has been asleep at all. It is quite possible that this was the case with the operator in question, as there was a snow storm at the time which would do a great deal towards muffling the noise of the slowly moving No. 3.

EX-TELEGRAPHER.

Railway Signal Association.*

At the meeting of the Railway Signal Association, held in Chicago, March 19, Mr. F. B. Corey, of the General Electric Company, read a paper on the Charging of Storage Batteries from Alternating Current Circuits, the main part of which is reprinted in this issue of the *Railroad Gazette*. This is a subject which has been of much interest to telegraph, telephone and signal engineers for a number of years. Almost all lighting plants are alternating and this explains in part why storage batteries have not been more rapidly introduced on telegraph and telephone as well as signal circuits; for to use this current it was necessary to install motor generators which are not only costly but undesirable for outlying points owing to the skill required in their maintenance. All of the objections to the different methods spoken of in Mr. Corey's paper were discussed by the members at Chicago, but the discussion was limited mainly to a comparison of the tube and motor generator sets. If, as this paper indicates, the mercury arc rectifier tube is a success the operation of outlying signals will be materially advanced.

Mr. Mock (Detroit River Tunnel Co.) suggested that comparative figures should be reported to show the relative value of the various systems, but no figures were obtainable because of the limited number of installations now in use.

Mr. Short (I. C.) has 27 plants at which he is using motor generator sets to charge storage, and two plants where he is using mercury arc rectifier tubes. He said that the average cost for installing motor generator sets was approximately \$180, and rectifiers \$200 each.

Mr. Corey said that the life of the tubes described in his

*The other doings of this meeting were reported March 23.

paper under normal operating conditions would be at least 600 hours; some running as high as 2,000 hours. One tube in a laboratory test operated for 8,000 hours. Answering a question as to whether the burning out of the tube destroys it, he said not necessarily, the supply of mercury being simply exhausted. The cost of materials required to make the renewal is so small that it scarcely pays to return them to the factory to be refilled. Mr. Corey said that the tubes do not decrease in efficiency with age. The question of labor in operating is simple. The arc rectifier needs no attention after the charging has been begun, and the current saved by its use is so great that it pays to make renewals as frequently as necessary. Motor generator sets need continual lubrication or other attention; there is continued expenditure for oil and waste, and they consume more current than the rectifiers. If there is a drop in voltage on the line side of the rectifier (below 28) the tube assumes the normal position and the battery is taken off charge, and unless some one is present to start the charge by adjusting the tube there will be an interruption to the completion of the charge. To meet this condition self-starting switches have been designed and are in use to a limited extent.

Mr. Mock compared the two systems and figured a net saving of \$2,400 in ten years in favor of the rectifier, assuming the life of motor generators to be 10 years and that of tubes at 600 hours.

The details of operating the two systems were minutely discussed and the consensus of opinion was in favor of the installation of rectifiers for charging batteries in signal service. A point in favor of the rectifier is the fact that in putting them in use on a line from 5 to 15 miles from the power plant no adjustment of reactance is necessary, for it is self compensating, whereas with motor generator sets the motor needs adjustment for the various drops in voltages. This increases the cost of installation.

With this development of mercury arc rectifiers new fields are opened for the economical use of storage batteries, particularly in districts remote from current supply. The records, as far as available, show that the use of transformed alternating current does not, as has been believed to be the case, affect the life of the battery plates.

The next meeting of the Association will be held at the Grand Union Hotel, New York, on May 8, at which time the three-position signal and the installation of all-electric and mechanical interlocking plants without detector bars will be discussed.

The Pennsylvania Railroad's Extension to New York and Long Island.

THE LONG ISLAND CITY POWER STATION.

The Pennsylvania Railroad Company has had under consideration for a number of years plans for establishing a terminal for its lines on Manhattan Island. The earliest of these contemplated a bridge over the Hudson River with elevated approaches and terminal in the City of New York.

The demonstration that electric traction was practicable for heavy train units made possible, however, an entrance by means of tunnels, which would enable the adoption of a well rounded out plan for a terminal which would embrace not only the Pennsylvania Railroad main line business, but through connection with New England and the railroad system on Long Island.

The announcement that the Pennsylvania Railroad Company proposed to enter New York City was made in May, 1902, and since that date the project in all its features has been actively underway.

It is the purpose of the present series of articles to describe the progressive development of the terminal plans in their transportation, engineering and architectural features, the present article being a description of the first unit in the construction which has been completed in operative condition, namely, the Long Island City power house. Other articles will follow as rapidly as they are prepared and as the development of the plans warrants.

ORGANIZATION.

Two companies have been incorporated through which the Pennsylvania Railroad Company is carrying on its New York extension work. One of these, the Pennsylvania, New Jersey & New York Railroad Company, will build all of that portion of the tunnel and approaches in the state of New Jersey and extending under the Hudson river to the boundary line of the states of New Jersey and New York; from this boundary the other, the Pennsylvania, New York & Long Island Railroad Company, will build the tunnels, terminal station and yards on Manhattan Island, under the East river and in Long Island City. The officers of these companies are officers of the Pennsylvania Railroad Company, the President being Mr. A. J. Cassatt.

The engineering and architectural features are subdivided in accordance with the character of the work, the whole project being under the general direction of the management of the Pennsylvania Railroad.

The tunnel work proper is divided into two parts, the East

River Division being under the direct charge of Mr. Alfred Noble, Chief Engineer, and the North River Division under the direct charge of Mr. Charles M. Jacobs, Chief Engineer; the general railroad facilities and the electrical and mechanical features of the railroad and terminal are under the charge of Mr. George Gibbs, Chief Engineer of Electric Traction. These three officials, together with Brigadier-General Charles W. Raymond, Chairman, constitute a board of engineers to whom the general engineering features of the whole plan are entrusted. In addition, advisory committees consisting of officers of the road have been appointed to pass upon and work out the special problems relating to the required railroad facilities, and pass upon the adequacy of the operating features as developed by the labors of the various departmental bodies.

It will be seen that by this comprehensive organization a harmony of operation with proper degree of independence is effected, which, while it keeps the officials of the Pennsylvania Railroad in close touch with the enterprise in all its stages, relieves them of multiplicity of detail.

POWER HOUSE ARRANGEMENTS.

The magnitude of the work to be done very early led to the decision that to secure reliability of service, as well as convenient power distribution, there should be two main generating stations, sites for which could be more readily obtained if they should be located one in New Jersey and the other on Long Island. The latter station would also naturally be used as the main source of power for the Long Island Railroad lines as fast as equipped, and the electrification of the Atlantic avenue improvement, which was pending when the general project took shape, required the early construction of the Long Island City power station.

The flexibility of the alternating current system of power transmission permits the generating station to be placed at any reasonable distance from the natural center of load that may be dictated by the important considerations of condensing water supply and cheap coal delivery, and the proximity of the East river was obviously advantageous for both these purposes. Such a site was fortunately available in Long Island City, and it had the additional advantage of a location convenient to the Long Island Railroad freight yard, which facilitated the cheap handling of coal and ashes by rail, as well as the delivery of building materials and equipment during construction. The site consists of an entire rectangular block with the short side toward the river, extending 200 ft. north and south on Front street and on West avenue, and 500 ft. deep along Third and Fourth streets.

STATION CAPACITY.

At the time the design was undertaken, the extent of electrification in sight was such as to necessitate station capacity of not less than 50,000-k.w., and probably more. A station of such size requires for economical operation generating units of the largest practicable size. When the decision was made the largest size of steam turbines and generators that had been standardized was of 5,500-k.w., and this size, therefore, became the unit basis of the power station design. The rectangular shape of the lot, practically 200 ft. x 500 ft., made it possible to plan a station that could readily be extended to occupy the entire block. The adopted design will permit the disposition of fourteen 5,500-k.w. generating units in the building covering the block, or about 105,000 electrical h.p. if such an amount of power be eventually required.

For the initial load that was to be placed upon the power station during the earlier years of the Long Island Railroad electrification, it was decided that three 5,500-k.w. units would suffice. The building as designed for this initial equipment covers the full width of the block and half its length, and contains room for six 5,500-k.w. units and two 2,500-k.w. units of the same type to be used for lighting the tunnels.

As now built, therefore, the station can hold more than double its present equipment, and when extended in size will accommodate more than four and one-half times the original installation of electrical generating machinery.

DETAILS OF CONSTRUCTION.

The site was formerly under water and had only been filled in to an extent that brought the surface about 1½ ft. above the extreme high water. A series of borings showed that the soil consisted of from 10 ft. to 15 ft. of loose fill and river mud overlying successive strata of clay, sand and gravel, with rock at a depth of 35 ft. to 60 ft. below the level of the street.

The structure and equipment of a large power station involved the carrying of heavy concentrated loads upon the side walls, building columns and machinery foundations which have to be properly distributed over the underlying soil in a manner that will secure absolute stability and uniformity of settlement. In the design of this foundation it was finally decided to use a comparatively uniform spacing of piles overlaid by a monolithic concrete mass of a thickness which should take up the distance between the point at which the piles could be safely cut off and extreme high water.

The point selected for pile cut-off was 2½ ft. below mean high tide. Test piles indicated a safe carrying capacity for piles from

30 ft. to 35 ft. long, of 13 tons to 20 tons, varying on different parts of the site. The foundation is designed to carry a load of 12 tons per pile, and the spacing of the piles is on an average 2 ft. 4 in. between centers over the entire area. The total number of piles required for the foundation was 9,115.

The top of the concrete cap was placed at elevation 303.5, based on P. R. R. datum, which is 300 ft. below mean high water. The proper distribution of column loads down through the grillage beams and the concrete cap to the tops of the piles required the thickness of the cap to be 6 ft. 6 in., which in turn enabled the cutting off of the piles 2 ft. 6 in. below high water level, in a water-bearing stratum of river mud, thus insuring perpetual moisture sufficient to preserve the piles from decay.

Underneath the stacks the concrete cap is 8 ft. 6 in. deep, the piles being cut off 2 ft. lower down. The stack anchor bolts pass through a grillage of steel T-rails, embedded in the bottom of the concrete.

In reviewing the character of this construction, it should be remembered that nearly all large power stations are, for the same reason that dictated the location of this one, placed adjacent to bodies of water of considerable size, and in such a location the adjacent soil is frequently of a soft or treacherous character. This type of foundation is eminently well suited for a power house so situated, as when finished it closely resembles natural bed rock in its ability to sustain concentrated loads as heavy as are likely to be met with, and is entirely free from the necessity of rearrangement, should circumstances attendant upon the development of a

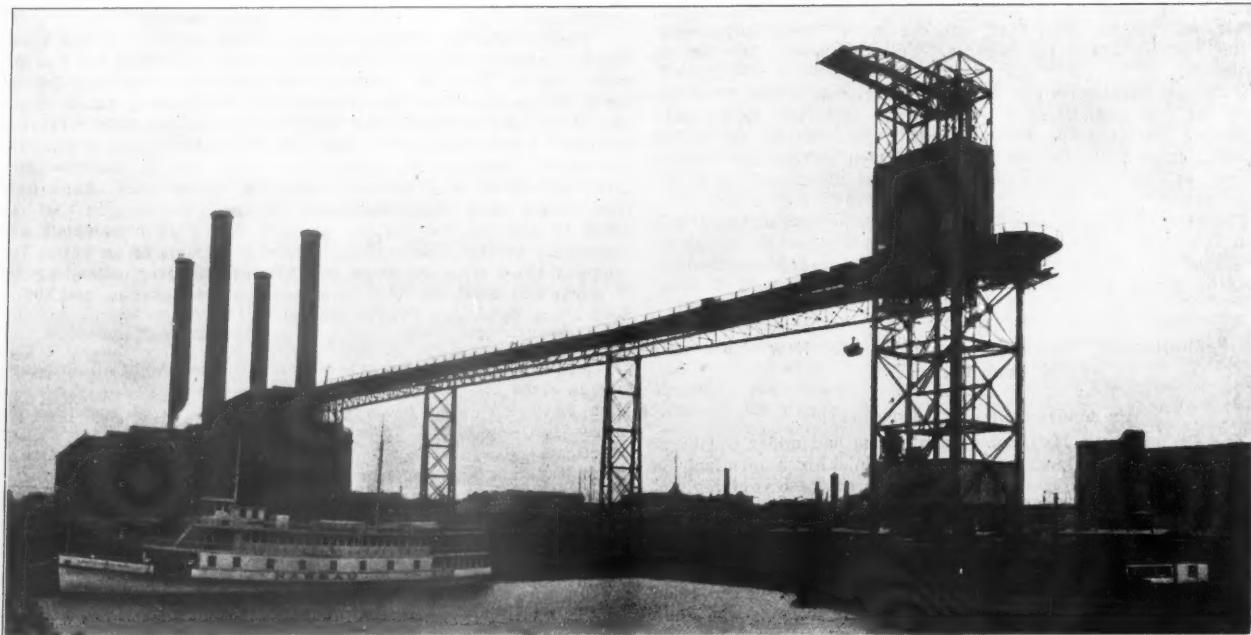
The intake being underneath the overflow, the circulating water must be lifted from it past the overflow flume, and to accomplish this a well is provided in the concrete foundation reaching down from the surface of the concrete cap to the bottom of the intake flume. The circulating water discharge pipe from the condenser drops directly from it into the overflow flume.

The work of excavation was begun Oct. 20, 1903. The only difficulty encountered was a layer of quicksand which made necessary the driving of 6-in. sheet piling for the whole length of the site on the Third street side, and for a part of the distance on the Fourth street side. A sump was located at the corner of Third and Front streets by means of which the excavation was kept drained until the concrete was finished. The entire area was excavated for 2 ft. below the level at which the piles were cut off in order to allow for the raise of the ground as the piles were driven.

Spruce piles were used, varying in length from 25 ft. to 40 ft. They were driven practically to refusal with a 2,000-lb. hammer falling 18 ft. to 20 ft. The first pile was driven on Nov. 16, 1903, and the last one on March 5, 1904.

COAL TOWER FOUNDATION.

The foundation construction for the complete plant and equipment includes the foundations for the coal unloading tower on the dock, and of the ash bunker and two coal bridge piers in the yard. The arrangement of the steel structures of the towers erected upon these foundations was such as to permit the use of the yard for railroad purposes. This is especially true of the arrangement of



General View of Long Island City Power Station from River, Showing Coal Tower in Operation—Pennsylvania Railroad.

change or increase in the power station equipment require the shifting of loads upon the foundation subsequent to its construction.

The flume for the condenser intake, and the overflow flume directly above it, traverse the building foundations completely from west to east, and are integral with it. Both the intake and the overflow flumes are nominally 10 ft. in diameter, this large sectional area being required to provide sufficient condensing water with a low velocity of flow when the power station is extended to its maximum future length of 500 ft. and filled with generating machinery.

At the bulkhead line the intake is provided with an ice fender, extending to a point below the extreme low water, in order to prevent a boat that may be lying against the face of the timber rack from packing ice against it and stopping the water supply. This timber rack extends from the bottom to the top of the intake opening, and is built of 3-in. x 10-in. yellow pine timbers spaced 4 in. apart in the clear.

The flume is made entirely of concrete, which, at the outer end of the intake flume, is reinforced vertically and horizontally by corrugated rods. Between the power station and the bulkhead the flume runs underneath the freight yard, which necessitated the reinforcement of the considerable portion of the overflow flume with 15-in. I-beams. The concrete roof of the overflow was further reinforced under the I-beams with expanded metal.

The general plan of the foundation indicates the method of handling the condensing water supply to and from the flumes. The condensers are placed directly under each turbine foundation,

the coal unloading plant on the dock, which was carefully planned to save this valuable property for other requirements.

The coal dock on which the unloading tower was placed is opposite the foot of Third street, and the tower is about 500 ft. from the river wall of the power house and offset somewhat to the south, causing a horizontal bend in the apparatus for delivering coal from the unloading tower to the power house bunkers.

The design for the coal handling apparatus called for the construction of a tower 170 ft. high, with a hoisting boom projecting 43 ft. 6 in. over the slip at a height of 163 ft. above the dock, coal being passed by gravity through crushers to a cable railway operating on level track and arranged to automatically dump coal at the required points in the bunker over the boiler rooms.

The elevation of the rail of the cable railroad is 107 ft. above the general surface of the railroad yard. This height of lift was decided upon in order to do all the work of hoisting in one operation, and to cover in this single hoist all the vertical space necessary for dumping into the crusher and loading hoppers, the location of the crusher and the crusher coal storage and loading hoppers and weighing apparatus being directly over the cable railroad.

The cable railroad operates on a level track so as to prevent runaways and consequent difficulties. In order to insure suitable operation of such apparatus it was felt desirable to have a very rigid foundation for the main tower on the dock, especially since it was likely to receive shocks from boats on both sides of the pier in which it stood. The dock at the point where this tower is located is approximately 55 ft. in width and the river bottom is

20 ft. below the dock. The base of the hoisting tower is 30 ft. by 37 ft. 4 in., the longer dimension being crosswise of the dock.

The foundation of the tower practically extends the entire width of the dock. An examination of the river bed on the site of this tower showed that the rock, while not far below the bottom, presented a sloping surface, but at no place was there a great quantity of earth between the bottom of the harbor and the rock. It was therefore necessary to devise some method which should retain and reinforce the piles and prevent any tendency to side displacement.

A crib was therefore provided which is 46 ft. wide and 50 ft. long, having its walls of 12-in. x 12-in. timbers solidly built up and fastened with $\frac{3}{8}$ -in. dock spikes, the sides being tied together by four interior partitions, two in each direction. Two of these compartments thus formed were provided with floors to form loading pockets for the sinking of the crib. A section was cut out of the dock sufficiently large to permit the introduction and sinking of the crib and the site was dredged to within 2 ft. of the highest point of the rock. The crib was then constructed in an adjacent slip, towed into position and sunk.

After placing a sufficient quantity of riprap to prevent movement out of true position the piles were driven, in the four corner compartments, down to rock, and were cut off flush with the top of the crib at a point below mean low water. The interior of the crib was then filled with riprap placed between the piles, and the top of the crib, where it was to support its load, was capped with

The first floor of the boiler house is 16 ft. above the basement, and the second floor of the boiler room is 35 ft. above the first floor. In the engine house the engine room floor is 23 ft. 6 in. above the basement, and thence to the roof trusses the height is about 40 ft. in the clear. This is a much lower engine room than is commonly met with in power stations of this size, the saving in head room being due to the adoption of the horizontal type of steam turbine, which enables economy in vertical space required as well as in the floor area.

STEEL CONSTRUCTION.

Like all large power stations of modern construction, the superstructure of the buildings consists of steel framework which carries the weight of the room and the entire contents of the building excepting such portions of the machinery as may be more conveniently carried on separate foundations. The south wall of the boiler house supports the outer ends of the boiler room roof trusses on that side of the building, but in other respects the steel superstructure is independent of the building walls.

The steel framing of the boiler house and engine room are necessarily different in type, as the former has to carry a double tier of boilers with flues, economizers, with a coal pocket of 52,000 tons capacity on top of everything, while the engine room consists of simply a large open space which makes the roof truss construction the most conspicuous feature, but aside from this does not involve any difficult construction. Conditions in the boiler house are, however, more complex, chiefly by reason of the imposition of the coal pocket which runs the entire length of the building.

The steel stacks are independent of the boiler house excepting where it passes through the lower fire room floor, at which point the floor is built against the stacks. At other points they pass through circular openings in the floors and roofs, so that there is no stress induced upon the structure by deflection of the stacks under stress of wind.

The columns are grouped in the most effective manner to carry these heavy concentrated loads. Their bases are supported on grillages of steel beams embedded directly in the monolithic concrete foundations which underlie the entire structure.

The first steel was placed in position on the foundation on March 17, 1904, and the steel erection was completed about the 20th of September, 1904.

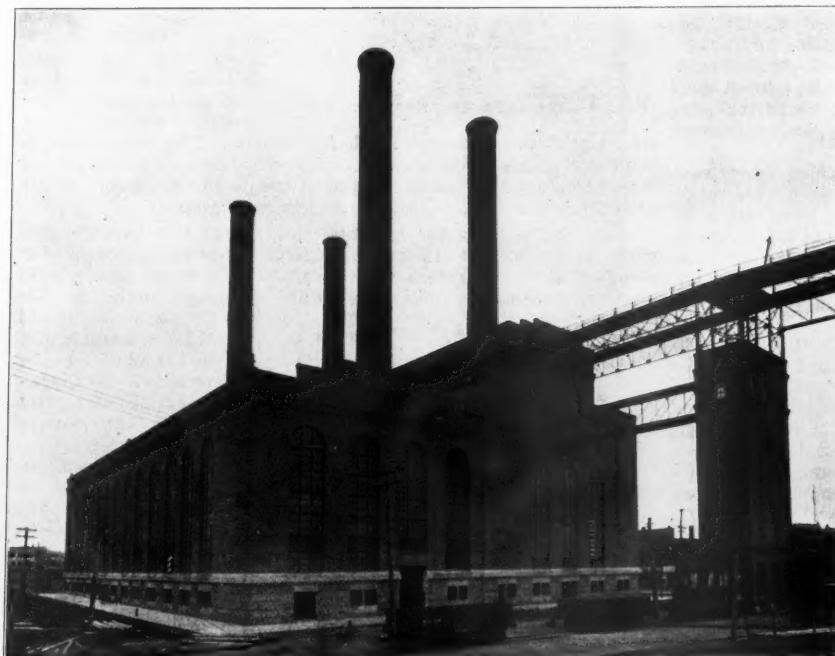
COAL AND ASH HANDLING STRUCTURE.

The foundation of the coal tower has been already described. The rather unusual height of its structure was due to the adoption of the level cable railroad to convey the coal from the hoist to a position where it could dump by gravity into the coal pocket without any intermediate hoisting operations.

The completed structure may be said to consist of three parts, the coal hoisting tower, the bridge supporting the cable railroad, and the ash bin structure which is so arranged that it forms a part of one of the piers of the cable railway bridge. This level bridge is 107 ft. above the dock, and is at about two-thirds the entire height of the tower, whose top is 170 ft. above the dock.

From the foundation up to the level of the cable railway the width of the superstructure of the tower is nearly the full width of the dock, and the structure consists of essentially four heavy corner columns of the box pattern thoroughly braced to each other in all directions, except below the engine room floor, where latticed bracing is omitted in order to accommodate the railroad equipment on the three tracks passing through the tower along the dock. The floor on which is located the hoisting apparatus is 25 ft. above the dock, and the space around and over this floor is enclosed for a height of 14 ft., forming an engine room for the hoisting mechanism. The sides of this engine room are made of expanded metal and plaster, and the roof of cinder concrete, tar and gravel.

The upper third of the tower, extending above the level of the cable railway, carries the hoisting boom, the receiving hopper, coal crushing and weighing apparatus, and the cable railway machinery. It is about half the width of the lower two-thirds of the tower, but in other respects is similar in construction, consisting of heavy columns substantially braced in all directions. The boom is 68 ft. long over all, and projects 43½ ft. beyond the northerly face of the tower and over the slip at an elevation of 162 ft. above the dock. It consists of two parallel trusses thoroughly braced on top, and with portal braces at each panel point. It supports the trolley carriage from which the hoisting bucket is suspended, and



General View of Long Island City Power Station and Ash Tower—Pennsylvania Railroad.

a double layer of 6-in. x 12-in. timbers, the upper layer being laid at right angles to the lower, and the concrete piers supporting the corner columns of the tower were constructed on these timber caps.

A considerable space around the crib, formed by the slopes caused by the excavation was filled with riprap, forming a solid and continuous buttress on all sides. The resulting construction thus forms a solid mass 46 ft. wide and 50 ft. in length and 27 ft. deep, extending well below the river bottom with the piles carrying the weight to bed rock, and the timber crib and its riprap reinforcing its bracing and securing all parts against lateral displacement.

As thus executed, no cofferdam, cut stone masonry, or expensive hand labor was required below water level, but a massive and stable structure was obtained by the employment of cheap materials, simple methods and cheap labor.

The foundations for the piers and ash bunker in the yard required no special treatment, but were carefully carried out in the same general manner as all the other foundations on the work.

DIMENSIONS.

The overall dimensions of the present building are 200 ft. x 262 ft. outside measurement. The boiler house is 103 ft. wide inside, the engine room 66 ft., and the electrical galleries 25 ft. wide. The boiler house proper is 82 ft. high to the top of the parapet. The coal pocket enclosure, superimposed on the boiler house, is 60 ft. wide, and its parapet is 118 ft. high. The engine room is 70 ft. high to the top of the parapet.

over whose drums the hoisting cables operate. The track for this trolley is carried by brackets on the bottom chord of the boom. The top chord of the boom was so designed as to properly compensate for the deflection due to the heavy trolley and a hoisting stress of 12,000 lbs. applied at its outer extremity.

Between the coal tower proper and the boiler house structure, a distance of about 500 ft., there are four spans of bridge construction supporting the cable railway.

The ash bin is directly across Front street from the boiler room, and ashes are delivered to it through a bridge at an elevation of 69 ft. above the street by means of a telpherage system which hoists and transports the ash cars from the boiler room basement up to the level of this bridge and thence over into the tower, where the contents are dumped into the bin. The bottom of the bin is 20 ft. above a railroad track that runs through the base of the tower, and the ashes are handled through dumping gates into gondola cars standing on this track. The capacity of the bin untrimmed is 300 tons.

(To be continued.)

Charging Storage Batteries from Alternating Current Circuits; the Mercury Arc Rectifier.*

BY F. B. COREY, GENERAL ELECTRIC COMPANY.

* * * The places where direct current power is available for signal batteries are comparatively few. Alternating current circuits, however, are found extending over the country in all directions, but in order to use such alternating current circuits for charging storage batteries some means must be available for rectifying this current, i.e., converting it into direct current. Where such existing circuits are not available, a single alternating-current generating plant with high-tension transmission and rectifying substations will be found, in many instances, to be an economical plan.

Of the means used for rectification, the single-phase rotary converter requires careful attention and does not possess a wide range of regulation. The motor-generator set is more complicated in construction, though more simple in its operation; but for machines of small capacity their efficiency is low and the cost is high, considering their capacity. Synchronously driven rectifiers are unsatisfactory, and the chemical rectifier has not proved to be a commercial success.

The mercury arc rectifier is a device which, although recent, has been developed to a point where it has assumed considerable commercial importance. Large numbers of these rectifiers are now in successful operation. While its principal application has been the charging of batteries for automobile service, it has been successfully used to operate direct-current arc lamps, small d. c. motors, and for other purposes for which direct current is essential. Its low first cost, small floor space, high efficiency and simplicity of operation all serve to render it an almost ideal apparatus for use in charging batteries for automatic signals and those used for electric interlocking. With this apparatus a skilled mechanic or electrician is not necessary, which fact is proved by the successful operation of those rectifiers by owners of automobiles. The mercury arc rectifier, as its name implies, consists primarily of a mercury-vapor arc, this arc being enclosed in an exhausted glass vessel of peculiar construction. Fig. 1 shows the standard form of tube with the metal caps which serve to protect the electrodes from injury and through which connections are made to the various circuits.

Mercury vapor in its ordinary, or molecular condition, is practically a non-conductor of electricity. Such vapor might be formed by applying heat to a mass of mercury enclosed in a vacuous chamber. If a body of vapor thus formed were subjected to the action of an electromotive force, either continuous or alternating, its resistance would be found to be very great. If, however, the mercury vapor is ionized—in other words, if the atoms of mercury in this vapor are electrified—the electrical resistance to current in one direction will be very small, while its resistance to current in the opposite direction will still be great. To use a very crude analogy, its action on an electric current is similar to the action of a check valve on a current of water flowing through a pipe.

The ionization of mercury vapor is easily accomplished. If an arc is formed between one mercury electrode and another electrode, the mercury being the negative, ionized mercury vapor will result. When a mercury arc is formed, as in the mercury arc lamp, the negative electrode being mercury, the resistance of this arc is small, but only to current of one direction. Hence it is seen that the current in a mercury arc must be uni-directional. This brings us to an understanding of the action of the rectifier. A mercury cathode is provided and two anodes of suitable material are connected across the terminals of an alternating current circuit, thus becoming alternatively positive and negative. The arc shifts from one anode to the other with each alternation, always passing from a positive anode to the negative cathode. The current in the wire

connected to the cathode is, therefore, always in the same direction.

The direct current delivered by the mercury arc rectifier is very different in its characteristics from that delivered by the synchronously driven rectifier. As mentioned above, the current from the synchronously driven machine consists of a series of pulsations each separated from the others by a certain small interval. If we were able to operate a mercury arc rectifier, in accordance with the above theoretical considerations, without any accessory apparatus, this rectified current would be composed of a series of pulsations, but without the separating gaps mentioned, the current wave being similar in form to the impressed alternating current wave, except that the negative half would be transposed, so as to become positive with reference to the zero line. This, however, is not the case.

If, when a mercury arc is once established, the current falls to zero, even for the most minute interval of time, the arc is extinguished, and certain means are necessary for its re-establishment. It is, therefore, necessary to insure that the current through the mercury arc rectifier shall not fall to zero, and so cause an interruption of the arc. The means used to bring about this result are reactances introduced in the circuit of the rectifier, and so designed as to obliterate the pulsations, so far as needful, and make the resulting current continuous.

Bearing in mind the fact that the current flow through mercury vapor must always be in the same direction, a clear understanding of the mercury arc rectifier may be secured by a careful study of the diagram, Fig. 2. In this diagram, A and A' are the operating anodes; B is the cathode; C is the starting anode; E and F are reactance coils, and G and H are the terminals of the alternating current supply. The battery to be charged is connected between cathode B and the point D between the two reactance coils. The rectifier is supported by a movable frame, so arranged that the top of the tube may be tilted slightly in starting. This movement of the tube forms a bridge of mercury between the cathode B and the starting anode C, and current may then flow between them through the mercury. When the tube swings into its normal position, this bridge is broken and an arc of ionized mercury vapor is formed. This ionized vapor, ascending in the tube to the anodes A and A', permits a flow of current from each of them in turn to the cathode B, and the tube is then in operation through a starting resistance. The load switch is then closed, and the starting anode and the starting resistance are both disconnected by opening the starting switch. Automatic starting devices have been used to some extent, but the operation of starting, as above described, is so extremely simple that the necessary complications incident to the use of automatic devices are not considered advisable, except in special cases.

From inspection of Fig. 2 it will be seen that the alternating current circuit is through the mercury arc, the battery and one of

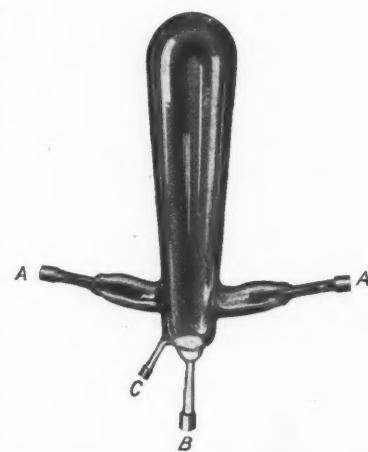


Fig. 1—Mercury Arc Rectifier Tube.

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*A paper read before the Railway Signal Association at Chicago, March 19. Condensed.

the reactance coils, one-half of the wave being through the anode at the right and the reactance at the left of the diagram, while the other half wave flows through the anode at the left and the reactance at the right. When the impressed e.m.f. falls below that required to overcome the counter e.m.f. of the mercury arc (about 14 volts) plus the load, the reactance which has been receiving current from the line discharges, maintaining a current in the same direction. This action maintains the excitation of the anode, and prevents the current from approaching the zero value until the voltage at the other anode has risen to a point where an arc is started between it and the cathode. To make this action more plain, the path of the current through the battery, due to one side of the wave, has been shown in plain arrow heads, while that due to the other half of the wave is indicated by the arrow heads in circles.

* * * The action of the rectifier tube is independent of the frequency of the alternating current circuit. Standard outfits can be operated on any frequency from 25 to 140 cycles, inclusive, thus covering the whole range of commercial circuits.

On account of the action of the reactance coils the voltage delivered by any given rectifier will vary somewhat with changes in frequency. Rectifiers are designed to deliver direct current at

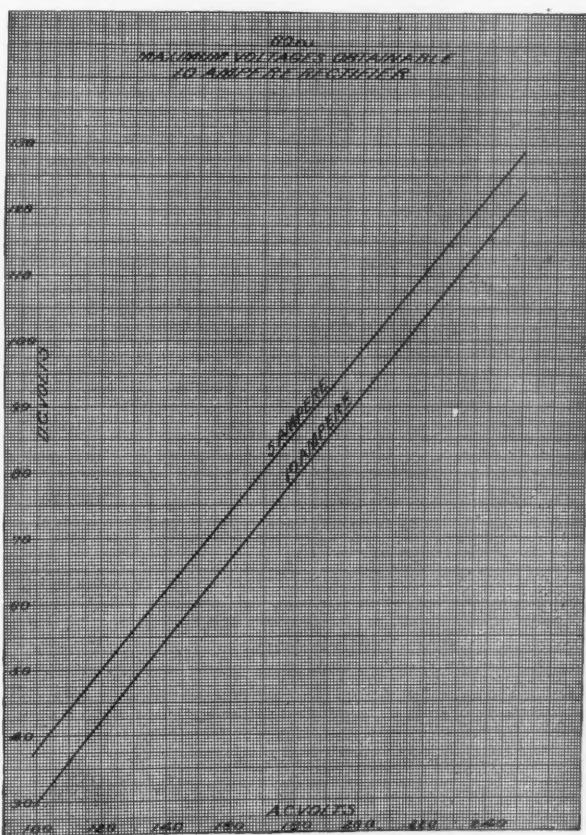


Fig. 3—Regulation of Ten-Ampere Rectifier.

voltages up to 200, and special rectifiers are supplied for somewhat higher voltages when required. According to the connections used, the direct-current voltage varies from 20 to 25 per cent. of the impressed alternating voltage.

The mercury arc rectifier is furnished in three standard sizes, viz: 10 amperes, 20 amperes and 30 amperes. In case a greater current capacity is desired, any number of tubes may be operated in multiple, making the maximum current capacity practically unlimited. In electric generators the only limit to be considered is the maximum, but in the mercury arc rectifiers we have also to consider the minimum limit. For instance, the minimum current on which a 10-ampere rectifier can be operated is approximately three amperes. By a proper arrangement of charging switches at each signal the batteries connected to the charging circuit may be thrown into a series-multiple arrangement, thus increasing the current and reducing the voltage of the charging circuit. The increased transmission losses incurred by such an arrangement are more than offset by the small losses in the rectifier itself, as compared with other charging apparatus.

The drop in voltage across the mercury arc is constant, so that the efficiency varies with the direct-current voltage delivered by the rectifier. The efficiency of the 10-ampere rectifier operating from a 220-volt 60-cycle circuit quarter load to full load is over 80 per cent.

for direct-current voltage averaging 112, it being practically constant for all loads between quarter and full load. In this respect it shows a marked superiority over the motor-generator set.

Another valuable property of the mercury arc rectifier is its inherent regulation which obviates the necessity of moving the regulating switch so frequently during charge, as would otherwise be the case. This inherent regulation, with standard reactances, is from six to eight per cent., with changes in d.c. load. When the e.m.f. of the battery increases during charge the current decreases, and as this occurs the voltage of the rectifier rises, thus tending automatically to compensate for the increased voltage of the battery. Fig. 3 shows the regulation of the 10-ampere rectifier. So far as I know, storage battery manufacturers agree that no harm can result to the battery from the rapid variations in current strength, and some are of the opinion that charging through a rectifier is more efficient, on account of better chemical action and less gassing.

The life of the rectifier tube varies in much the same way as the life of incandescent lamps, it being dependent on the maintenance of the vacuum. The life of the tube under normal operating conditions is at least 600 hours. Two tubes are always shipped with every panel, and the cost of the renewals is small.

The saving in cost of operation of the mercury arc rectifier set over a motor-generator set, when charging a 44-cell battery, has been shown by tests, when figured at 6 cents per k.w.-hour, to be 56½ cents per charge.

Cost per charge, motor-generator set.....	\$1.867
Cost per charge, mercury arc rectifier.....	1.302
Saving per charge.....	\$0.565

Assuming the minimum life figure of 600 hours:
Seven hours per charge equals 85.7 charges during life of tube.
Total saving during life of tube = \$0.565 × 85.7 = \$48.42.

Michigan Railroad Tax Law Upheld.

The Supreme Court of the United States on April 2 decided against the railroads in the Michigan Railroad tax cases, involving the taxes of all the railroads in that state for several years past. The opinion was by Justice Brewer.

There were 27 cases, all involving the validity of an act of the Michigan Legislature of 1901 changing the method of taxing railroad and kindred corporations from the old system of exacting the payment of a certain percentage of their gross earnings to an ad valorem system, providing for the fixing of the value of the railroads for taxation on the average value at which other property in the state is assessed. The taxes levied against the various railroads of the state for 1902, the first year after the new law went into effect, aggregated \$744,898, as against \$263,446 which would have been called for under the old system. The railroad companies tendered the latter sum and resisted the payment of the difference, amounting to \$481,451. Each year since the companies have refused to pay the difference, so that the suits involved an accumulation of about \$2,000,000 in taxes, as well as the establishment of a tax system for the state permanently fixing their annual payments at about three times as much as they have been in the past. The railroad companies contended that in arriving at a decision as to the valuation of their property the State Board of Assessors undervalued other property in the state 17.6 per cent. and thus discriminated against the railroads. Hence, they alleged that the action was in contravention of the Fourteenth Amendment to the Federal Constitution. The Circuit Court dismissed the bill of the railroad companies, thus sustaining the action of the tax authorities and upholding the law under which it was taken; and this decision is now affirmed.

Justice Brewer, delivering the unanimous opinion of the court, said there had been frequent occasions to consider questions of state taxation in the light of the Federal Constitution, and the scope and limits of national interference were well settled. There was no general supervision on the part of the nation over state taxation, and in respect to taxation the state had, speaking generally, the freedom of a sovereign, both as to objects and methods. In view of the frequent and uniform expressions of opinions by the Supreme Court, the Fourteenth Amendment would not prevent a state from changing its system of taxation in all proper and reasonable ways nor compel a state to adopt an ironclad rule of equality in taxation. The decision in effect holds that a tax levied on railroads is not necessarily illegal because it bears more heavily on that property than upon other property in the same state, and, further, that the Federal courts will not interfere in the matter of state taxes unless the constitutional rights of the owners of the property taxed are clearly infringed.

The railroads contended, also, that the law taxed property in other states; that debts were not deducted, as they were in valuing other property, and as it taxed property used partly in other states it was an attempt to regulate interstate commerce.

Justice Brewer accepted as final the decision of the Michigan court as to the validity of the tax law under the state constitution. Remarking on the contention of the railroad companies that the

fixing of the rate of taxation by the state authorities as authorized by the state law is a legislative function, Justice Brewer touched on a point now receiving much attention in Congress and in the public prints. He said:

"There might be a question whether, even if there were a clear delegation of legislative functions to other departments of the government, it would be void under the Federal Constitution. In the nation no one of the three great departments can assume or be given the functions of another, for the Constitution distinctly grants to the President, Congress and the judiciary separately the executive, legislative and judicial powers of the nation. It may, therefore, be conceded that an attempted delegation by Congress to the President or any ministerial officer or board of power to fix a rate of taxation or exercise other legislative function would be judged unconstitutional. But does it follow that a state is subject to the same restraint? Crimes against the nation must be prosecuted by indictment, yet a state may proceed by information. Suppose a state by its constitution grants legislative functions to the executive or to the judiciary, what provision of the Federal Constitution will nullify the action? Will the grant work an abandonment of a republican form of government, or be a denial of due process or equal protection?"

Coming to the case at issue, he said there was no abandonment by the Legislature of its functions. He added:

"The state prescribes as the rate of taxation upon railroad property the average rate of taxation on all other property subject to ad valorem taxes. It provides the most direct way for ascertaining such average rate, deducing it from a consideration of all the other rates. No authority is given to the local assessors to apply their judgment to the question of the railroad rate. Their authority in respect to the matter of taxation is precisely the same as it was before and independently of this statute. . . . Why is it necessary that the Legislature be convened to add its formal approval of the integrity of the action of the local officers? May it not intrust the mathematical computation to the State Board of Assessors, and, if so, may it not likewise act upon the assumption that the local assessors will discharge their duties with an eye single to these duties and irrespective of the effect upon the railroad rates? It may be laid down as a general proposition that where a Legislature enacts a specific rule for fixing a rate of taxation, by which rule the rate is mathematically deduced from facts, and even this occurring within the year and created without reference to the matter of that rate, there is no abdication of the legislative function, but on the contrary a direct legislative determination of the rate. Unless there be some specific provisions in the state constitution compelling other action the state may treat its entire territory as composing only a single taxing district and deal with all property as within the district and subject to taxation accordingly. The state is traversed in almost every direction by railroads. To hold that for each railroad the average rate must be determined from the property in the localities immediately contiguous or through which its road passes might well introduce into the matter of taxation a confusion and inequality resulting in far greater injustice than the uniformity established by the present system."

"So far as the restraints of the Federal Constitution are concerned it is within the power of a state to separate a particular class of property, subject it to assessment and taxation in a mode and at a rate different from that imposed upon other property and apply the proceeds to state rather than local purposes. This is not open to question."

The opinion passes over the other questions raised in the case as not of paramount importance, and concludes:

"It is enough to say that generally we accept the findings of a trial court upon a question of fact when the testimony respecting it is conflicting. It may also be said that a Legislature is not bound to impose the same rate of tax upon one class of property that it does upon another. As it may exempt all of one class, so it may impose a different rate of taxation. It is sufficient if all of the same class are subjected to the same rate and the taxes administered impartially upon them."

National Association of Railway Commissioners.

The eighteenth annual convention of this body was held in Washington, April 2, 3, 4 and 5. The roll call of the first day showed commissioners or clerks present from the states of Connecticut, Georgia, Illinois, Indiana (C. V. McAdams), Kansas, Kentucky, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New York, North Carolina, North Dakota, Pennsylvania, South Carolina, South Dakota, Washington and Wisconsin (John Barnes and B. H. Meyer). Also representatives from the American Railway Accounting Officers and the Street Railway Accounting Association. All of the Interstate Commerce Commissioners were present.

The President of the Association, Mr. W. G. Smith, one of the commissioners of South Dakota, delivered the opening address, discussing chiefly the questions of state regulation and of safety, which

have been before Congress and the public during the past six months. The only report adopted on the first day was that of the committee on the classification of expenses on electric railways. This committee, in co-operation with representatives of the American Street and Interurban Railway Accountants' Association and of the Association of American Railway Accounting Officers, proposes to hold a meeting within three months to consider proposed changes in forms, with a view to arranging the classification of operating expenses of steam and street railroads, so that all practicable uniformity may be reached.

The convention again adopted (for the eighteenth time, we believe) a resolution declaring that Congress ought to require the railroads to adopt a uniform classification of freight.

The reports of the committee on safety appliances and on other subjects are deferred to a future issue.

Map of New York Freight Terminals.

The engraving on the opposite page, which explains itself, is reduced from one published in the *Railway Equipment Register*.

Washington Correspondence.

WASHINGTON, April 3.—President Roosevelt and the radical Republican Senators have surrendered to the conservative advocates of amending the Hepburn railroad rate bill so as to provide explicitly for the judicial review of orders issued by the Interstate Commerce Commission, but they have done so in such a way as to complicate the situation rather than clarify it. When the limited review amendment indorsed by the President, by Attorney-General Moody, and by the radical Republican Senators was given out at the White House on Saturday evening it was claimed that it would have the support of twenty-nine Republicans and of enough of the Democrats to insure its adoption. It was soon found that this was an overestimate of its strength, and all of the Republican support that is now claimed for it is sixteen, with the probability that this is an overestimate. It has also been repudiated by many of the Democrats, and there seems to be little probability that it could get a majority of the Senate if it should be brought to a vote. On the whole, the interjection of the Administration amendment has probably increased the difficulty that will be encountered in arriving at an agreement on the text of the review amendment to be adopted.

An event that may have more to do with shaping the action of the Senate on the Hepburn bill than the introduction of the President's amendment was the announcement by Mr. Justice Brewer on Monday of the decision of the Supreme Court in the Michigan railroad tax cases. This decision was looked upon in some quarters as a virtual notice to Congress that the Supreme Court would hold the Hepburn bill to be unconstitutional. One of the contentions of the railroads was that the Michigan law required the assessors to perform a legislative function in fixing the rate of taxation of railroad property by a mathematical computation based on the average of the other rates in the state. The Supreme Court upheld the Michigan law, but the reasoning by which this was done, it is believed by some Senators, would, if applied to the Hepburn bill, insure its being declared unconstitutional. Justice Brewer interjected into his opinion a declaration not necessary to the decision of the case before the court as to the division of the powers of government between the executive, legislative and judicial branches, in the declaration that "an attempted delegation by Congress to the President or any ministerial officer or board of power to fix a rate of taxation or exercise other legislative functions, would be unconstitutional." The decision has not yet been published officially, and it is understood that when it is published this part of it will be stricken out because some of the other justices, while concurring with Mr. Justice Brewer's opinion as a whole, object to this as an unnecessary expression of opinion on a point not involved in the case. The court held that the question of a state statute attempting to confer legislative power on an administrative agency was not involved in this case, for the reason that the Michigan legislature had not attempted to do so, and it is the part of the decision showing that no such attempt was made that has the most direct bearing on the question of the constitutionality of the Hepburn bill. One ground on which the court held that no such attempt had been made was that the Michigan law gave no authority to the assessors to apply "their judgment" to the question of the railroad tax rate. If this means that a requirement that they should apply their judgment would bring the question of the validity of such a state enactment under the Federal constitution into the case, it is questioned what view the court would take of the Hepburn bill, which proposes to require the Interstate Commerce Commission to prescribe what will in "its judgment" be the just and reasonable and fairly remunerative rate. It is hardly probable that the court would follow one rule as to a tax rate and another as to a freight rate. The court also finds that the question of the delegation of legislative power was not involved in the Michigan cases, for the reason that the state law prescribes "a

specific rule" for fixing the rate of taxation, in accordance with which the actual rate can be determined by a "mathematical computation." This, it is suggested, is an indication that the court would require the fixing by Congress of some definite standard or specific rule for the determination of freight rates by the Interstate Commerce Commission, such as a provision that the rate should be a certain amount per ton per mile. The Commission could then determine the rate by a "mathematical computation."

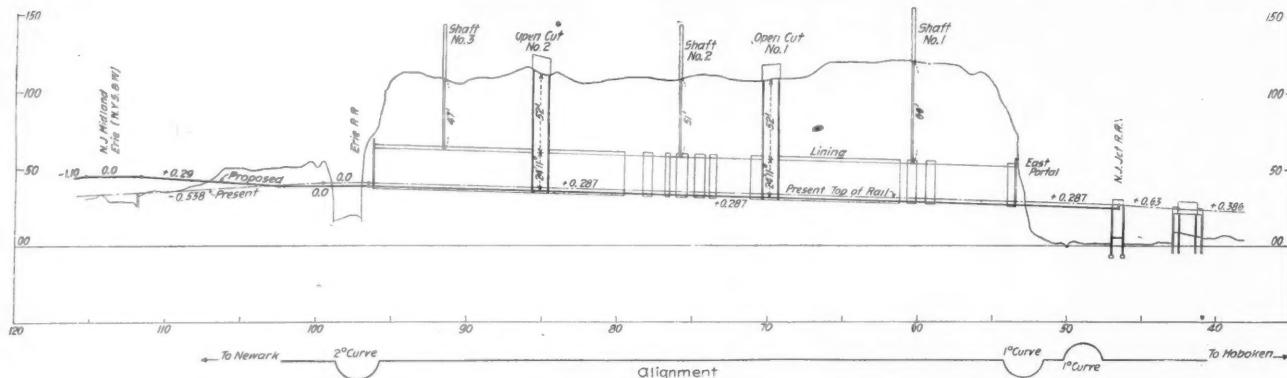
This decision has so strongly reinforced the arguments of Senator Foraker as to the unconstitutionality of the basic principle on which the Hepburn bill is based that it may lead to a reconsideration of the provision conferring the rate-making power and to an attempt to modify it so as to increase the probability that it will stand the test of the courts. It is not probable, however, that any very material change will be made in this part of the bill, but it will

The New Bergen Hill Tunnel of the Lackawanna.

BY J. H. PHILIPS,

Assistant Engineer Delaware, Lackawanna & Western.

The present Bergen tunnel of the Lackawanna Railroad is situated one mile west of the Hoboken Terminal, and is a single tube for double-track, 4,280 ft. long. At the west end of this tunnel is the junction of the Morris & Essex, or the "Old Road" with the Boonton Branch, or as it is now called, the Main Line. The "Old Road" is purely a suburban line, and runs through Harrison, Newark, the Oranges, Summit and Morristown, and joins the Main Line just east of Dover, having branches from Roseville to Montclair and from Summit to Bernardsville and Gladstone. The greater part of the people in these towns do business in New York City and commute daily to and from their business. The Boonton



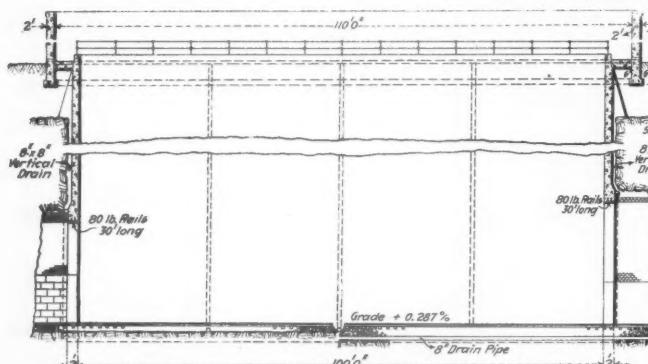
Profile of New Tunnel Through Bergen Hill—Delaware, Lackawanna & Western.

be passed despite the protests of Senator Foraker and possibly a few other Senators, and the Supreme Court will be called upon to decide whether it involves an attempt to confer on an administrative commission the functions of the legislative branch of the government. J. C. W.

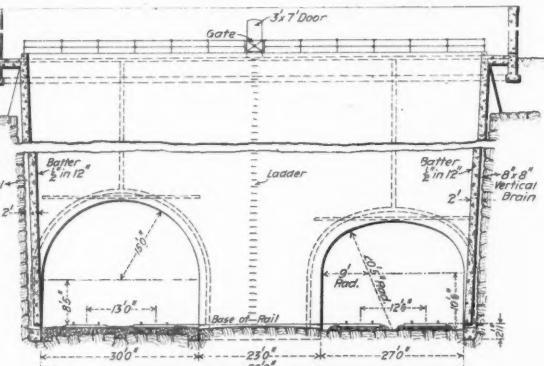
J. C. W.

The Italian authorities are charged with designing to use free passes on the state railroads for political purposes, and to moderate criticism of the railroad management. The government has submitted to Parliament a bill concerning the subject. This provides for extending pass privileges, formerly secured by law to certain government officers, to the families of senators and deputies. Further, the Minister of Public Works is authorized to issue monthly not more than 60 single-trip passes, good for not more than five per-

Branch, or Main Line, is the more direct route to Buffalo, and all through passenger trains, with one or two exceptions, and all freight trains are run over this route. All freight for Hoboken, Jersey City and New York, and all export freight, besides the immense volume of suburban passenger traffic, has to pass through this tunnel, which is seven-eighths of a mile long, and is operated as a single absolute block. As there are more than 100 trains (scheduled) each way in 24 hours, besides the great number of freight extras taking freight to and from the terminal, it can be readily seen that this absolute block nearly one mile long within a mile of the river front is a great handicap to the operating department, and it has been thought for several years to be an absolute necessity to get more tracks through Bergen Hill. To relieve the congestion at this point is the object of the new tunnel tube



Longitudinal Section of Tunnel at Open Cut.



Cross Section of Tunnel at Open Cut.

sons each, and 100 tickets at reduced rates "to be allotted to persons who have done the state service, or for other reasons"—which here probably would be interpreted as available for packing conventions, etc. Similar privileges are authorized for retired railroad officials, including those of the companies formerly working the state railroads. As "members of the family" shall be considered parents, grand parents, sons under 25, unmarried or widowed daughters, widowed daughters-in-law living under the same roof, and two servants per family. Tables of the classes of officials, etc., entitled to passes are contained in the bill. With regard to the press, Italian journalists and editors of important foreign periodicals may have as many as three tickets, personal or family, at reduced rates, and one free pass per year, taking into consideration the number of the journalists and the importance of each journal, under regulations to be fixed by the Ministry after hearing the Italian newspaper union and the syndicate of foreign correspondents in Rome.

through Bergen Hill, the contract for which has been let to the William Grace Co., of New York and Chicago.

The new tunnel will be a single tube for double-track 4,280 ft. long with portals flush with those of the present tunnel and having three air shafts and two 100-ft. open cuts across both tunnels. The new tube will be built parallel with and distant 51 ft. 6 in. southerly at right angles from the center line of the present tunnel, leaving a wall of natural rock between the two tunnels of from 19 ft. to 23 ft. in thickness, depending on whether the old and new tunnels are lined or not. The new tunnel will be built on the same grade as the present tunnel, which is descending eastward at the rate of 18 ft. per mile, as shown in the profile.

The material to be penetrated is solid trap rock and is classified as follows: Tunnel approach excavation to include all excavation outside the portals; tunnel excavation to include all excavation of the tunnel between portals and shaft excavation to in-

clude all excavation from shafts down to the roof of the tunnel. The material from the approach excavation at the east end of the tunnel will be wasted in a fill between the east end of the tunnel and the West Shore tracks.

All material from the tunnel tube and from the west approach will be loaded on cars furnished by the railroad company on side tracks adjoining the work, and all suitable rock will be hauled to Boonton, N. J., and crushed in the railroad company's crusher and

built in the shaft lining at a height to be determined by the engineer.

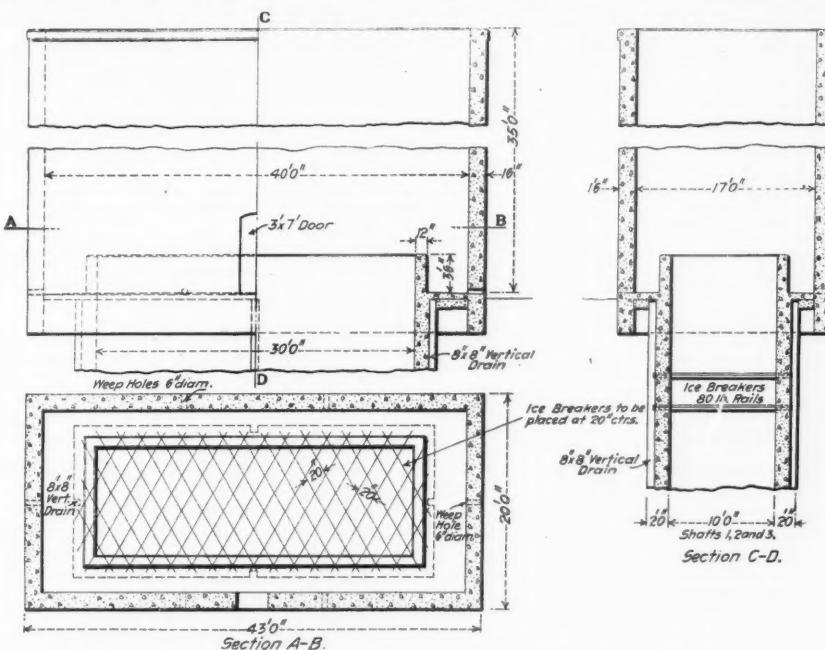
Two open cuts, 100 ft. long, will be built across the width of both tunnels, each about one-third distant from either end of the tunnel. These open cuts will be lined with concrete throughout, the end walls being vertical and the side walls being built on a batter of $\frac{1}{2}$ in. per foot. A wall of concrete about 20 ft. above the surface of the ground will be built around each of these open cuts to keep persons from throwing stones, etc., on the cars below. A ladder of iron steps will be built up one of the end walls of each open cut located between the two tunnels. The construction of these two open cuts will probably make it possible to operate the tunnel in three blocks instead of one as at present.

During the construction of the new tunnel, an inspection engine equipped with platforms and searchlights will be run through the present tunnel to inspect the roof of the tunnel after each blast, before letting any trains through either way. The periods of blasting will be limited to four periods of 15 minutes each in 24 hours, when the schedule will be arranged to accommodate this.

All sand, stone, cement, vitrified brick, vitrified tile pipe for drains and conduits, steel rails, doors and door frames for shaft houses and open cut enclosures will be furnished by the railroad company on the site of the work, the proportions of the concrete mixture are also to be made as the engineer directs. The furnishing of all material by the railroad company stops all controversy between the railroad company and the contractor about the proportions of material used in the mix. It also allows the contractor to carry work with less investment of capital. Wet concrete is preferred, and will be put in, except in extreme cold weather. A smooth face will be obtained by spading the stone back from the face of the wall.

When dry concrete is used, a facing mixture of one part cement and three parts sand will be placed next to the face boards.

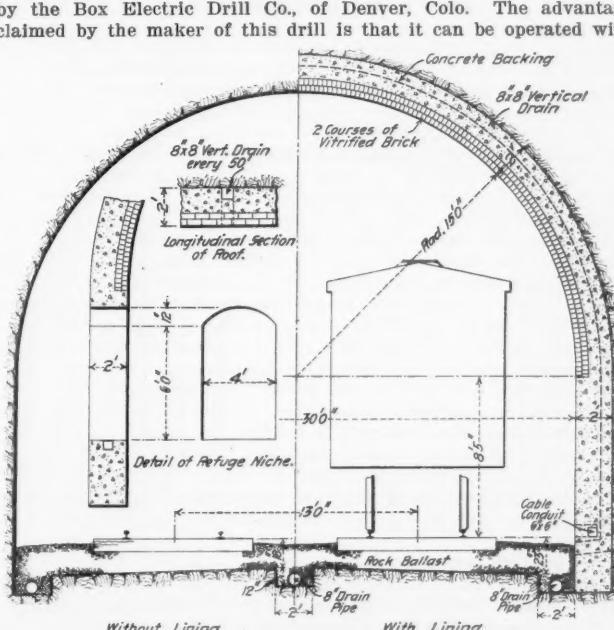
The contractors have arranged to install an electric plant and will use electric drills on this work. The drills will be furnished by the Box Electric Drill Co., of Denver, Colo. The advantage claimed by the maker of this drill is that it can be operated with



Details of Shaft and Shaft House, New Bergen Hill Tunnel—Delaware, Lackawanna & Western.

used for ballast. The contractor will crush sufficient rock from suitable excavation to furnish all crushed rock used for concrete in this work. The contractor will be paid an additional price per cu. yd. for all rock so crushed. The earth excavation from shafts and open cuts may be wasted by the contractor in dumps to be arranged for by him. The portals of the new tunnel will be built of concrete and the new tunnel tube will be lined for at least three-quarters of its length. The side wall lining will be of concrete, and the arch will be lined with two rings of vitrified brick laid on edge, backed by concrete. The lining will be 2 ft. thick, as shown in the illustration of the tunnel section. It was decided to line the arch of the tunnel with two courses of vitrified brick backed with concrete instead of using all concrete arch lining, to obviate the possible damage to the roof lining from engine gases or blast effect from engine exhaust. The tunnel will be 30 ft. wide, with a semi-circular roof 30 ft. in diameter, the springing line of the arch of the tunnel being 8 ft. 5 in. above the base of rail. The roadbed will be so cut as to drain to the side ditches, and three ditches, each 2 ft. wide and 1 ft. deep, will be cut at the center of the roadbed, in each of which a line of 8-in. vitrified drain tile will be laid. One cable conduit, 6 in. square, will be built in each concrete side-wall. The top of the conduit will be 6 in. above the base of rail, and its nearest edge will be 8 in. from the face of the side-wall. Hand holes 8 in. square and 14 in. deep will be left in the side-wall at sufficient intervals to give access to cables. Six refuge niches, two located at each of the air shafts, 4 ft. wide and 6 ft. high, will be left in the sides of tunnel lining for the use of workmen. Weep holes, made of vitrified tile, will be built at the bottom and through the side walls where the tunnel is lined. These will be spaced 50 ft. apart or less. Vertical drains, 8 in. square, will be left in the concrete lining, extending from the weep holes to the crown of arch and located in the back of masonry, next to the natural rock.

Three air shafts, 10 ft. by 30 ft. inside, will be built for ventilation. The two side walls of these shafts will be even with the side walls of the tunnel and all of the shafts will be lined with concrete 2 ft. thick. Shaft houses, 20 ft. by 40 ft. inside, located at about 35 ft. above the surface of the ground, will be built around each of these shafts. The details of the shafts and of the shaft houses are shown in the illustration. The surface inside of shaft houses and outside of shafts will be covered with concrete. The shafts will be drained by means of weep holes left in the sides of shaft house walls. Vertical drains will also be left in the back of shaft lining on both sides and ends, and will be connected with the side ditches of the tunnel. Metal ice breakers of 80-lb. rail will be



Cross Section and Details of New Tunnel Through Bergen Hill—Delaware, Lackawanna & Western.

1½ h.p. to 2 h.p. per drill, while the steam and compressed air drills require about 15 h.p. per drill.

All plans and specifications for this work were worked up under the personal direction of Lincoln Bush, Chief Engineer, assisted by A. J. Neafie, Principal Assistant Engineer, and Mr. E. I. Cantine, Division Engineer. Mr. L. H. Evans, Contracting Engineer for the Wm. Grace Co., will have charge of the work for the contractors.

President Stickney on Rate Regulation.

The following extract is from a paper by A. B. Stickney, President of the Chicago Great Western, printed in the Political Science Quarterly for March, 1906.

If the disease has been properly diagnosed, what is the remedy? For nearly half a century the railroad companies have tried to abolish the rebate system by agreement amongst themselves not to pay rebates. To destroy such agreements it has not been necessary for the large shippers even to make a protest. They have only to route all their shipments over one of the competitive lines and pay the full tariff rates. Immediately thousands of stock-exchange tickers announce the increase in earnings of the favored line and the decrease in earnings of all the others. Tick, tick, tick, up go the stocks of the favorite, and tick, tic, tick, down go the stocks of the others. No management can stand against such attacks through the ticker. It has no alternative but to apologize humbly for the strike and agree to pay a still larger rebate in the future. The strike being thus ended, the commercial magnates have only to turn their whole traffic to the lines which have surrendered, in order to obtain full rebates on the traffic which the single line had carried during the strike under the impression that it was getting full tariff rates. It has thus been proved by experience that an agreement among the railroads to maintain tariff rates and pay no rebates is not a remedy.

Would consolidation of all the railroad companies into one huge corporation be a remedy? It seems altogether probable that the autocracy thus created would be strong enough to defy rebate-seekers. Whether it would destroy rebates would depend to some extent upon the personal interest in manufacturing and commercial enterprises of the railroad czar and of the grand dukes, his bankers, his uncles, brothers, brothers-in-law, sons and sons-in-law. If the reign of the first czar should be benign, what would be the character of the reign of his hereditary successors? The disclosures of the insurance investigation are not reassuring.

The autocracy would necessarily be localized somewhere, probably in New York City, thousands of miles from many of the activities which are dependent upon railroad transportation. It would entail upon the country evils akin to, if not essentially identical with, the evils of absentee landlordism, which has cursed Ireland, Russia and all the countries in which it has existed. Out of touch with the activities and the aspirations of distant communities, the czar would expect his managers to make present returns as large as possible, letting the future take care of itself. The ticker is always crying: "More, more!" Consolidation has already reached a stage which produces many complaints. It is alleged that no person authorized to act in redressing a wrong, or in meeting the needs of a new industry, can be reached without undertaking a journey across the continent and humbly submitting the case to the unsympathetic decision of the "unconscious arrogance of conscious power."

If, as is by no means certain, autocracy would be a remedy, the remedy may well be regarded as worse than the disease. With a grand duke in control of each of the great combinations which now command rebates, and the czar getting a "rake-off" as stockholder, or otherwise, from all, it does not seem probable that the chances of individual enterprise would be improved.

Would legislative control of rates be a remedy? It is a distinguishing characteristic of the American mind that it seeks to remedy every economic evil by passing a law. The average mind regards the enactment of the law as sufficient. The average mind is always in favor of enacting a law, but after the law is enacted the average mind is opposed to its enforcement. And when such a law has been enacted and no attempt has been made to enforce it and the evil continues to exist, the demand of the average mind is not to enforce the existing law but to enact a new law. Besides, if the statutes of this class be examined, it will be found that the average legislative mind possesses the same reverence for enactment and the same disregard for enforcement, and that, consequently, none of the statutes contains proper provisions for enforcement.

If it were not for these well-known characteristics, the fact that the Interstate Commerce law has been in existence for more than 18 years without results would be evidence that legislation is not a remedy for the rebate system. This law forbids in the most comprehensive language the rebate and other kindred evils, but it provides no adequate instrumentalities for its enforcement. Besides, its penalties are in many cases so out of proportion to the offence that this enforcement cannot be expected. For illustration: under this law, as originally passed, if a man rides on a pass from New York City across the state line into Connecticut he commits a misdemeanor, punishable by a fine of not less than \$1,000 nor more than \$5,000, or by imprisonment in the penitentiary for not less than one year nor more than five years, or by both fine and imprisonment, in the discretion of the court, for each ride. A later amendment abolished the prison penalty and made the fine not less than \$1,000 nor more than \$20,000. The same penalties

are imposed for paying rebates; and under the original law these penalties ran, not against the railroad company which paid the rebate and reaped the profits from the traffic which the rebate secured, but against the minor traffic agent, who, on a salary of perhaps \$2,500 per year, was supporting a family, and who, it might be claimed, had by a wink or a nod or by absolute silence agreed to pay the rebate. The writer was present at a controversy between a shipper and such an agent as to whether the agent had agreed to make the rebate claimed, and heard the following dialogue:

Shipper.—I spoke to you about the rebate at the time.

Freight Agent.—Yes; but I said No.

Shipper.—I know you said No, but there was a queer look in your face which I thought meant Yes.

On this evidence the rebate was paid in the interest of future traffic from the same shipper. What American jury would fine or imprison a man for having a queer look in his face when he said No?

In one of the outbursts of public excitement which have periodically occurred since the enactment of the law, one poor fellow was convicted; but the conviction so outraged common decency that the president promptly pardoned him. Speaking from recollection, this is the only conviction under the law in the 18 years of its existence.

Under the original law the penalties ran only against the payers of rebates, but a later amendment imposed the same penalties "for soliciting or receiving a rebate." This seemingly just amendment made it well nigh impossible to convict anybody, because the rebate crime is, as a rule, known only to the giver and the receiver. Neither party can testify against the other without incriminating himself, and this, under the provision of the federal constitution, no witness can be compelled to do. This predicament necessitated another amendment, which required both parties to testify, and avoided the constitutional provision by guaranteeing absolute immunity from prosecution for offences which such persons might disclose either to the Interstate Commerce Commission or to the courts. Since the passage of this amendment, the giver or receiver of a rebate has only to confess to become immune and to render both the Interstate Commerce Commission and the courts powerless to enforce the penalties of the law.

Under the Elkins amendment, the penalty of imprisonment was abolished, and the fine of not less than \$1,000 and not more than \$20,000 was imposed upon the railroad companies themselves as well as their officers and agents, and upon those who may solicit or receive a rebate. This amendment was passed in 1903, and no convictions have yet been made. It is a disputable question whether a railroad company will be immune against penalties if it produces its books or other testimony in court. A case involving this question is before the Supreme Court.

It is needless to add that the law has had little effect upon the rebate system. At the time of the first enactment, which was during a period of intense public excitement, and at the time of each subsequent enactment, and since the president has become "perniciously active" in attempting its enforcement, there have been, not organized and effective revolutions, but just common ordinary strikes against the rebate system. Like all strikes, they have lasted only as long as the excitement has lasted.

Notwithstanding the failure of the Interstate Commerce law during 18 years of trial, it is the conviction of the writer that it is possible to frame a reasonable and just law, with reasonable and just provisions for enforcement, which would be effective. Such a law cannot, however, be drafted off-hand, with a few days or even a few months for its consideration, during a period of excitement amounting almost to hysteria.

A law intended to establish and enforce just and reasonable rates must be framed with reference to the fundamental facts which are the basis of such rates. A great deal of intelligent investigation has been devoted to ascertaining the principles of economic operation, but no investigations have been attempted in respect to the fundamentals of reasonable rates. Ask the expert traffic official what is the basis of reasonable rates and by what method they can be ascertained, and, if he regards the question seriously, he must confess that he does not know. Ask the doctrinarians who write books, and they must confess that they do not know. The fact is nobody knows; nobody has the basis, the formula, or even a theory. Have reasonable rates relation to the cost of producing transportation, or to the interest on the fortuitous capitalization of each railroad company? Is a railroad company entitled to earn reasonable profits on cost of production, or reasonable interest on securities issued? Nobody knows. The people, the legislators and the courts are at sea upon these fundamental propositions. All is mystery.

If there are such things as reasonable rates, they must be based on something, have relation to something, which, by investigation, can be ascertained and demonstrated. If there are no such things, then in enacting laws which declare, as the present law declares, that "all rates shall be reasonable and just and that all unjust and unreasonable rates are unlawful," Congress simply

enacts a moral rule which no one will dispute and which no one can interpret or apply. If laws of this class, making those things criminal which the day before their enactment had been regarded as lawful, are to be enforced, they must be intelligible and explicable, so as to appeal to that sense of justice which is innate in the American people.

It is probable that such an investigation as is here suggested would prove that the net rates—the remainder of the rates after deduction of the rebates—are the reasonable and just rates which should be made the tariff rates, open to all shippers, alike.

It would therefore seem to be a wise procedure for Congress to provide an interstate commerce investigation committee, composed of, say, seven members, four members to be appointed by the president, and three members to be appointed by the railroad companies. One member should be a sound lawyer; one a mathematician; one an experienced railroad auditor; one an engineer of capacity, experienced in calculating costs of transportation; one a superintendent, experienced in the actual movement of trains and of rolling stock; one a station agent, experienced in the details of station or terminal service, and one a traffic manager, experienced in present rates. The committee should have authority to demand from the railroad companies a new line of statistical facts which have never been compiled, relating to costs, and particularly to relative costs as between the different conditions under which commodities are transported. To give a single illustration: the committee should demand statistics showing the commodities which require, under certain conditions, the hauling of only half a ton of non-paying car to each ton of pay-freight and, under other conditions, the hauling of three or four tons of non-paying car to each ton of pay-freight. The statistics should cover all the relations of weight of car to weight of load which this illustration suggests. There are other lines of facts which, like those just cited, would need only to be mentioned to show their relevancy to the problems to be investigated.

The investigation should be systematic and thorough; it should, above all, be public; and the results should be published from time to time so as to keep the public informed during the progress of the work, and to permit public discussions in the newspapers and elsewhere. There is no corrective influence so powerful as publicity; no other agency can secure thorough comprehension of the facts and proper control of the inferences.

After, but not before, such investigations, publications and discussions—if there remained evils which such investigations, publications and discussions had not remedied—it would seem possible to frame legislation which would be recognized as just and intelligible and which would accordingly prove to be enforceable.

Test of the Sauvage Air Brake.

BY GEO. L. FOWLER.

Ever since the introduction of the air brake into freight service it has been recognized that a means should be found whereby the pressure on the brakeshoes should be proportioned to the weight on the wheels. The current method of adjusting the leverages so that 70 per cent. of the weight of the empty car is used in brakeshoe pressure leaves only about 23½ per cent. of the weight of a loaded car of 60,000 lbs. capacity available as brakeshoe pressures, and this meagre percentage is cut down still further, so that it is less than 20 per cent. in the case of a car of 100,000 lbs. capacity.

The Sauvage safety brake is intended to overcome this trouble and to substitute for the ordinary arrangement one that permits the use of the full 70 per cent. of the loaded weight of the car. It also provides a greatly increased braking power with a small addition to present equipment, and with no increase in the consumption of compressed air, or it makes it possible to attain the present brake power with a considerable saving in the consumption of air. The device was tried tentatively on the New York, Ontario & Western Railroad in the summer of 1904, and in the fall of the year it was decided to equip the milk cars of the road. This has been done, in part, as fast as the work could be carried on at the Middletown shops, and early in September last a series of tests were made to determine the relative efficiency of this brake in comparison with the standard Westinghouse equipment.

The arrangement as used and recommended by the Sauvage Safety Brake Co., of 42 Broadway, New York, consists of a second cylinder coupled to the brake levers in such a way that it comes into action only after the piston of the first cylinder has traveled a predetermined portion of its stroke, brought the shoes to a bearing against the wheels and applied the ordinary braking pressures.

The illustration shows this connection. No change is made in the triple valve, auxiliary reservoir, or the brake cylinder connection, with the exception of the connection of the auxiliary cylinder. This is so arranged that its piston is not acted upon by the air until that of the first cylinder has done all of the work of taking up the slack and adjusting the brakeshoes to the wheels.

The air is admitted to the regular brake cylinder, A, in the usual manner from the auxiliary reservoir. When its piston has

moved out to a point uncovering the opening to the pipe, C, air is admitted to the rear of the second cylinder, B. In the meantime, while the piston of A is traveling out it is carrying the swinging lever to which the piston rod of the cylinder, B, is attached, with it, and this in turn, pulls out an extension of the piston of B, as will be explained later. It will be seen, then, that as soon as air is admitted to the second cylinder it transmits through the swinging lever a pull upon the cylinder lever at the point of attachment of the piston rod of A, twice as great as that of the latter if the cylinders are of the same size, on account of the multiplying effect of this lever. In this way, if the brake cylinder pressures were the same, the brakeshoe pressures would be three times as great as when the single Westinghouse cylinder were used, which is about the increase needed between an empty and loaded car of 60,000 lbs. capacity.

The mechanism by which the extension of the piston rod of the second cylinder is drawn out is shown in the illustration. The main piston rod is hollow and the extension telescopes into it. To the extension there is hinged the drop piece, or latch, D, which when lifted to the central position slides in the hollow rod. When it is drawn out beyond the edge of this hollow rod it drops down and catches on the end of the same, as shown in the lower portion of the engraving. Then when air is admitted to the second cylinder the rod catches on the drop piece and does its work through it.

When the brakes are released the two pistons retract together, and as the end of the drop piece, D, approaches the cylinder head it is raised by the inclined lug attached to the latter to its central position and slides into place in the piston rod.

A cut-out cock in the pipe C by which the second cylinder can be put out of use completes the mechanism of the new device, and in it there is nothing of complication or anything that is apt to get out of order. When it is desired to use the single cylinder on empty car work the cock in the pipe C is closed and the extension to the piston rod of the second cylinder is merely drawn in and out. To use the cylinder, the cock is opened, thus practically duplicating the work of attention required by the ordinary retaining valve.

It has been found to be unnecessary to close the valve for empty cars in service, as will be shown in greater detail later.

In order to provide for the semi-automatic adjustment of the cylinder and guard against the use of the second cylinder on an empty car where there might be a danger of flattening the wheels, various forms of automatic cut-out valves have been devised, one of the first forms of which is shown in section in the engravings, and its operation is as follows:

It is placed in the pipe C together with the cut-out cock, the latter to be used for emergencies only.

Within there are two valves, O and n, opening downward and held against their seats by springs. The stems of these valves project up into a cylindrical space in which a piston q is free to move up and down. Above this piston there is a disc with a packed stem r that can be depressed by the double-acting lever s. This is so constructed that no matter which way the upper portion is moved the central part will come down against the disk stem and push it and the piston down.

The device has been tested on a number of cars on the New York, Ontario & Western Railroad. The first trial was on a passenger train, where its work was so satisfactory that the equipment of all of the milk cars on the road was ordered, and this is nearly completed. These cars are of the ordinary type, are equipped with Fox trucks, and weigh empty about 38,850 lbs.

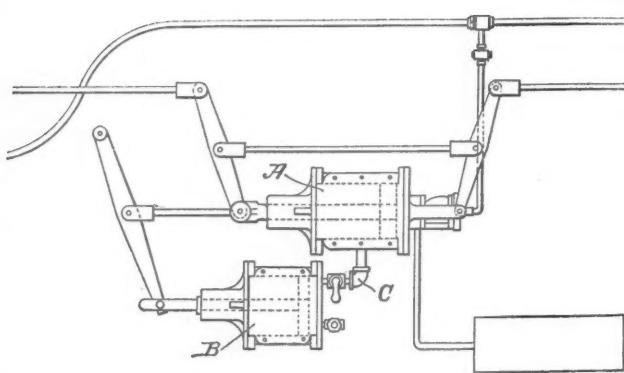
It was desired to make a comparative test of the stopping and working qualities of this new brake with the ordinary Westinghouse equipment, in order to obtain the stopping efficiency, the amount of air used and the control of the train. That this might be done, trains were placed at disposal for the execution of the work. This was done in the regular service of the road, with no interruption and no variation except as noted later. The cars, when loaded, carried about 30,000 lbs. of milk and 3,600 lbs. of ice each.

The main tests were made with the leverage recommended for use with the Sauvage brake against the high-leverage in connection with the Westinghouse brake.

The work was done between Sidney and Middletown, a distance of 121.31 miles. The trains used for the greater portion of the work, with the cars loaded, were in regular milk service scheduled to leave Sidney at 1.35 p. m. and arrive at Middletown at 7.30 p. m. On the return trip with empty cars the work was done on the trains scheduled to leave Middletown at 7.35 p. m. and arrive at Sidney at 1.25 p. m.

In order to secure an autographic record of the brake events throughout the whole period of the run, an instrument especially designed for the work was placed in the eight-wheeled caboose car that was attached to the rear end of each train tested.

This instrument was fitted with a driving mechanism by which a roll of brown manila paper 14½ in. wide was driven over the table and rolled upon a reel at the end opposite to that from which it started. The driving was done by gearing worked from one of the axles, and the reduction of motion was such that the paper



General Arrangement Sauvage Safety Brake.

traveled 20.75 in. for each mile traveled by the car.

The registering apparatus consisted of six stylographic pens, each of which drew a continuous line from one end of the run to the other.

The indications of the several pens were as follows:

The pen at one end of the row, which made the line shown at the bottom of the record, was attached to the armature of a double magnet, so arranged that if the circuit through one magnet coil was closed the armature would be drawn in one direction, whereas if that passing through the coil of the other magnet, it would be drawn in the opposite direction.

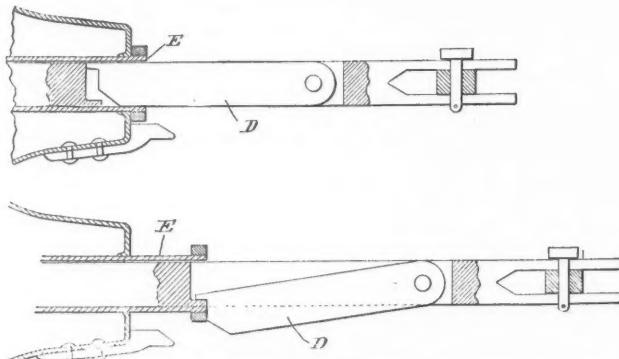
This pen was used to indicate the passing of mile-posts and stations. Two sets of circuit wires were led from the two magnets to the monitor of the caboose, and there provided with push buttons. According as the circuit was closed by one or the other of these buttons the pen was moved up or down, causing a notch to appear in the line, and thus locating the mile-post or station, as the case might be. The pen was moved upward to indicate mile-post and downward to indicate station location.

The second pen was attached to an armature whose magnet was in a circuit that was closed at intervals of 10 seconds by a clock. As the paper traveled at a speed in direct proportion to that of the car, the speed of the latter can be determined at any moment of time or place by the distance separating the notches on the second line, as they are farther apart the higher the speed. A suitable scale makes it possible to measure this speed at once.

The third pen was attached to an armature whose magnet was in a circuit closed by a wiper on the driving mechanism. These marks measure distances of about 570 ft., and were used as a check on the mile-post and for use in the determination of short distances.

The fourth pen was attached to the piston rod of a small cylinder, to the rear end of which the train pipe pressure was admitted. This piston was held normally at the rear end of the cylinder by a spring, which was compressed when the train pipe pressure was admitted. As this pressure was lowered by the application of the brakes, the spring pushed the piston back towards the end of the cylinder, carrying the pen with it and thus registering the reduction made for the application of the brakes.

The fifth pen was attached to the piston rod of a similar cylinder, to which the brake cylinder pressures were admitted. Normally the piston was held by its spring against the back head of the cylinder, to be pushed out, compressing the spring when the brakes were applied, thus registering the brake pressures used and indicating on the record where the work was done.



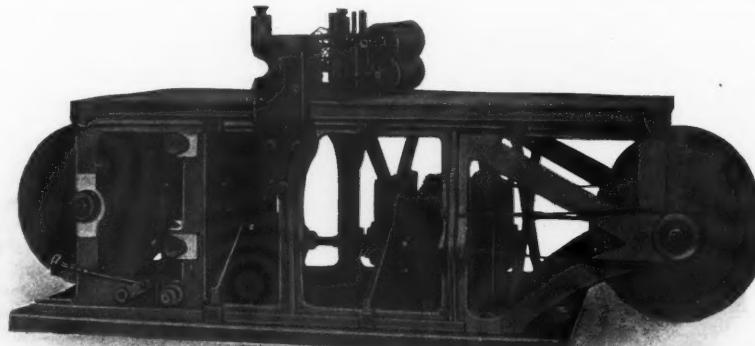
Detail of Auxilliary Cylinder Piston Rod and Latch of Sauvage Safety Brake.

The sixth pen was fixed and served merely to draw a base line.

The whole of the record was thus autographic with the exception of the indications for mile-posts and stations, which were made by an assistant in the monitor.

In this way a complete record, unaffected by the personal equation of the operator, was obtained showing the intensity, character and location of all the brake events, as well as the speed of the train with its accelerations and decelerations due to engine pull or brake applications.

In addition to this principal instrument a pressure recording



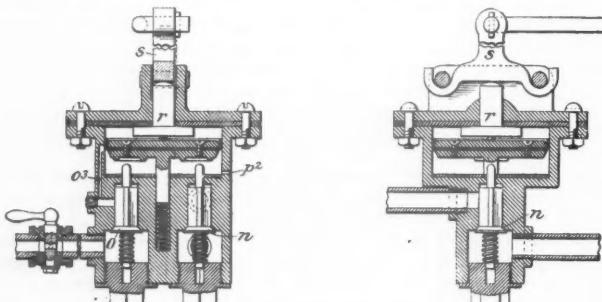
Autographic Recording Apparatus Used in Sauvage Brake Tests.

gauge was placed in the caboose and connected with the train pipe. On the engine there was a stroke counter attached to the air pump.

Work was commenced on a run from Sidney to Middletown on August 29, 1905, and finished on a run from Middletown to Sidney on September 12, 1905.

In all 10 runs were made. Of these three were with loaded cars and the Sauvage brake from Sidney to Middletown; three with loaded cars and the ordinary air brake, using the high leverage, over the same run; one the same as the above, except that the standard leverage was used; one from Middletown to Sidney with the Sauvage brake and empty cars; one the same as the last except that the Sauvage brake was coupled to the high leverage used with the ordinary brake, and one with the latter and high leverage.

The trains were hauled by the same engine and engineer with one exception, and were as near the same composition and weight as the exigencies of service would admit. There were some variations in the brake equipment, as will be noted. The following is a detail of the composition of the several trains that were used between Sidney and Summitville, between which points all of the special stops were made:



Sections of Sauvage Automatic Cut-Out Cock.

Date.	No. cars.	Brake.	Weight of train.	Direction of movement.	Remarks.
Aug. 29.	11	Sauvage.	761,290 lbs.	South.	One car was not fitted with Sauvage brake. Cloudy, wet and dry rail.
Aug. 31.	10	Ordinary.	774,838 "	"	Clear, dry rail.
Sept. 2.	7	Sauvage.	578,852 "	"	One car (6029) cut out. Rainy, wet rail.
Sept. 6.	9	Ordinary.	669,813 "	"	Clear, dry rail.
Sept. 7.	11	Ordinary.	540,600 "	North.	Clear, dry rail.
Sept. 8.	9	Sauvage.	687,239 "	South.	Clear, dry rail.
Sept. 9.	13	Sauvage.	629,600 "	North.	Clear, dry rail.
Sept. 10.	9	Ordinary.	675,362 "	South.	One car (6033) standard leverage. Clear, dry rail.
Sept. 11.	12	Sauvage.	582,300 "	North.	Foggy. Damp rail to Livingston Manor.
Sept. 12.	8	Ordinary.	642,443 "	South.	Cloudy, dry rail.

In this list the caboose is not counted in the number of cars, nor is the engine included in the weight of the train. This is placed at the uniform figure of 275,500 lbs.

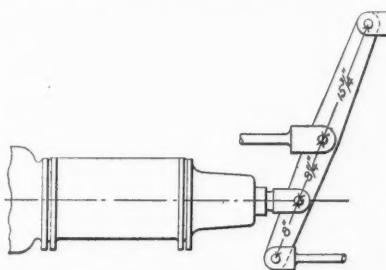
In doing this work arrangements were made for a series of special stops in each direction, so that comparisons could be made between the action of the two brakes at the same point in the track and at approximately the same speeds, independent of the regular service work.

The special stops were made as follows:

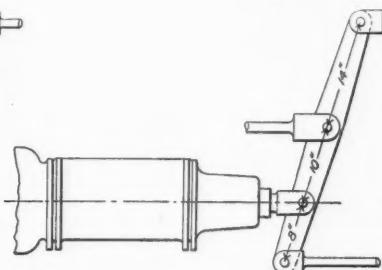
SOUTHBOUND (LOADED TRAIN).

Emergency Stops from Full Speed.

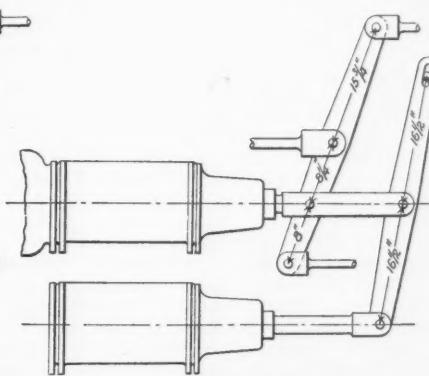
At mile-post 163, on descending grade of 74.45 ft. per mile into Cadusia.
At mile-post 150 (East Branch), level.



Ordinary Single Cylinder with Standard Leverage.



Ordinary Single Cylinder with High Leverage.



Sauvage Cylinders with Standard Leverage.

Method of Attaching and Cylinder Lever and Proportions Used in the Sauvage Brake Tests.

At mile-post 113, on descending grade of 59.66 ft. per mile into Luzon.
At mile-post 102 (Mountaintdale), descending grade of 64.26 ft. per mile.

Service Stops from Full Speed.

At mile-post 154 (Fish's Eddy), ascending grade 50.21 ft. per mile.

NORTHBOUND (EMPTY TRAINS).

Emergency Stops from Full Speed.

At mile-post 92, on descending grade of 52.8 ft. per mile into Summitville.

At mile-post 150 (East Branch), level.

At mile-post 189 (Franklin), descending grade of 66 ft. per mile.

Service Stops from Full Speed.

At mile-post 135 (Rockland), level.

At mile-post 171 (Rockrift), descending grade of 68.32 ft. per mile.

A higher leverage than that previously employed was used, and is shown in the engraving, in which the arms of the cylinder lever are 8 1/4 in. and 15 3/4 in. long, and which is marked "standard" lever-

as though three 8-in. cylinders were connected to and acting upon the end of the main cylinder lever.

A fourth engraving shows the arrangement of the foundation brake rigging under the milk cars with which these tests were made.

Following these leverages out from the cylinder to the brake-beam, it will be seen that the pressure upon the beam for each pound of pressure in the brake cylinder will be for:

Ordinary brake (Standard leverage)	2.22 lbs.
Ordinary brake (High leverage)	3.03 "
Sauvage brake	6.67 "

For an equalization of the brake cylinder pressures at 55 lbs. the brakebeam loads were as follows:

Ordinary brake (Standard leverage)	6,137 lbs.
Ordinary brake (High leverage)	8,376 "
Sauvage brake	18,328 "

For 60 lbs. this becomes for the ordinary brake with

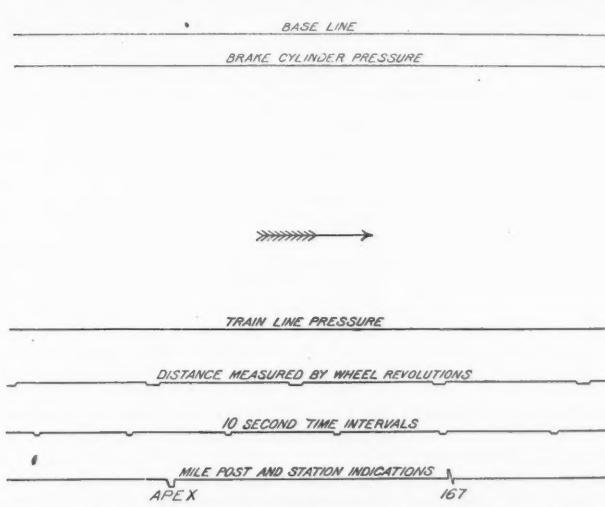
Standard leverage	6,695 lbs.
High leverage	9,137 "

It will be shown later that 55 lbs. was the maximum pressure obtained in the Sauvage cylinders. The average weight of the loaded car was 73,610 lbs.

These equalized pressures under emergency application therefore show the following percentage of the weight of the car in the brake-shoe pressure.

	Cars	
For 55-lb. brake cylinder pressure:	Empty.	Loaded
Ordinary brake (Standard leverage)	63.18 per cent.	32.80 per cent.
Ordinary brake (High leverage)	86.23 "	45.51 "
Sauvage brake	188.49 "	99.59 "
For 65-lb. brake cylinder pressure:		
Ordinary brake (Standard leverage)	74.66 "	39.46 "
Ordinary brake (High leverage)	101.91 "	53.79 "

In the case of these tests a train pipe pressure of 80 lbs. was used, which equalized in the cylinder of the caboose at 65 lbs.



Specimen of Autographic Record of Brake Events in Sauvage Brake Tests.

age. The high leverage is shown on the engraving, in which the lengths of the two arms are 10 in. and 14 in., respectively; a change that increased the pull on the rod leading to the trucks from .523 lbs. to .714 lbs. for each pound of pressure in the brake cylinder; an increase of 36.52 per cent.

In the case of the Sauvage brake, the arms of the main cylinder lever are of the same length as in the standard leverage arrangement of the ordinary brake. In addition to this the Sauvage cylinder is attached to a lever that doubles its pull on the cylinder lever; so that when the second cylinder is at work the effect is the same

It was the intention to use the same engine worked by the same crew during all of these trips; but, owing to the floods and the consequent disturbance of the service about the first of September, another engine of the same kind and weight, but with a different braking power, was used on the southbound run September 6, with a loaded, ordinary high-leverage brake. This extra braking power, amounting to about 42 per cent., tended to lower the length of the stops on that day.

The caboose was not equipped with the Sauvage brake. The result is that the pressure registered by the cylinder of that car is

167

somewhat higher than in the Sauvage cylinders on the balance of the train.

In order to determine just what allowance should be made for this, a standing test was made with the result that the Sauvage brake cylinders equalized at a lower pressure than the single cylinder of the Westinghouse system. The difference in their equalizing pressure amounts to about 10 lbs.; that is to say, with a pressure of 65 lbs. in the brake cylinder of the caboose the cylinders of the train would have a pressure of 55 lbs.

In addition it has been found, by means of a dynamometer placed in the pull-rod, that the stress actually transmitted to the brakeshoe is considerably less than that called for by theoretical considerations. This loss of power is due to the frictional resistance of the cylinder packing, the friction of the levers on their pins and the binding of the connections. In all, it amounts to about 22 per cent.

It follows, then, that the actual brakeshoe retarding force is much less than that called for by the theoretical calculations. Consequently, instead of having 188.49 per cent. of the weight of empty and loaded cars in brakeshoe pressure, it becomes 147.02 per cent. and 77.68 per cent. respectively.

The travel of the brake cylinder pistons was kept in careful adjustment throughout the whole course of these tests at from 5 in. to 6 in. with the ordinary brake, and from 7 in. to 7.5 in. with the Sauvage brake.

The accompanying engravings show samples of the work transcribed from the original. One shows the time, distance and location marks when running; a second is a copy of the record of the emergency stop made on September 8 near mile-post 164. A third is a short section from the details of the report showing the grade of the road, the location of the mile-posts, the points of brake application, the amount of train pipe reduction and the brake cylinder pressures. The upper set of lines and figures refer to the work of the Sauvage brake with a loaded train on September 8, and the lower lines to the run with a similar test and the ordinary brake with the standard leverage August 31.

The records of the special emergency stops were as follows:

Date.	Brake.	Location at milepost.	Grade, in feet per mile.	Speed per hour.	Time required to brake stop, in sec.		Distance in feet.
					from application	run after stop	
Aug. 29.	Sauvage.	154	+ 1.32	42 miles.	17.50	713	
Aug. 29.	"	113	-59.66	37	22.50	708	
Sept. 2.	"	163	-74.45	60	50.75	2,544	
Sept. 2.	"	150	Level.	41	31.00	1,173	
Sept. 2.	"	113	-59.66	46	29.22	1,228	
Sept. 3.	"	102	-64.26	44	33.30	1,123	
Sept. 3.	"	163	-74.45	60	42.80	2,114	
Sept. 3.	"	150	Level.	44	20.80	679	
Sept. 3.	"	113	-59.66	44	24.10	898	
Sept. 8.	"	102	-64.26	45.5	28.50	1,050	
Sept. 9.	"	189	-66.00	48	20.00	858	
Sept. 9.	"	150	Level.	48	19.40	687	
Sept. 9.	"	92	-52.80	52.5	31.10	437	
Sept. 11.	"	150	Level.	43	22.40	787	
Sept. 11.	"	92	-52.80	51	30.20	1,113	
Sept. 11.	"	163	-74.45	60	77.50	4,496	
Aug. 31.*	Ordinary.	150	Level.	42	...	1,202	
Aug. 31.*	"	113	-59.66	38	31.20	1,088	
Aug. 31.*	"	102	-64.26	45.5	51.90	2,099	
Sept. 6.	"	164	-74.45	60.5	45.70	2,293	
Sept. 6.	"	113	-59.66	59.5	46.50	1,734	
Sept. 6.	"	102	-64.26	47	40.00	1,622	
Sept. 7.	"	189	-66.00	52	31.20	1,218	
Sept. 7.	"	150	Level.	51	28.50	1,117	
Sept. 7.	"	92	-52.80	55	43.90	1,733	
Sept. 10.	"	185	-74.97	51	42.74	1,920	
Sept. 10.	"	163	-74.45	62	62.80	3,176	
Sept. 10.	"	150	Level.	39	18.16	729	
Sept. 10.	"	113	-59.66	50.5	51.20	1,700	
Sept. 10.	"	102	-64.26	40	38.60	1,230	
Sept. 12.	"	185	-74.97	57	50.60	2,306	
Sept. 12.	"	161	Level.	57	62.20	2,799	
Sept. 12.	"	150	Level.	42	37.00	1,033	
Sept. 12.	"	113	-59.66	49.5	39.50	1,448	
Sept. 12.	"	102	-64.26	46.5	41.10	1,571	

*Brakes worked with Standard leverage.

†Brakes worked with High leverage.

In these the ordinary brake was used with the standard leverages on August 31, and with the high leverages on September 6, 7, 10 and 12. The Sauvage brake was worked with the standard leverages at all times except on September 11, when it was attached to the high leverages.

In the comparison of these records a certain amount of grouping is required.

The runs with the Sauvage brake on August 29, September 2 and September 8 may be compared with the high-leverage tests of the ordinary brake on September 6, 10 and 12.

The same runs of the Sauvage brake may be compared with the standard-leverage test of the ordinary brake of August 31.

The run with the Sauvage brake of September 9 may be compared with that of the ordinary high-leverage run of September 7.

The run with the Sauvage brake, coupled to the high leverages, of September 11, may be compared with the run of the ordinary brake of September 7.

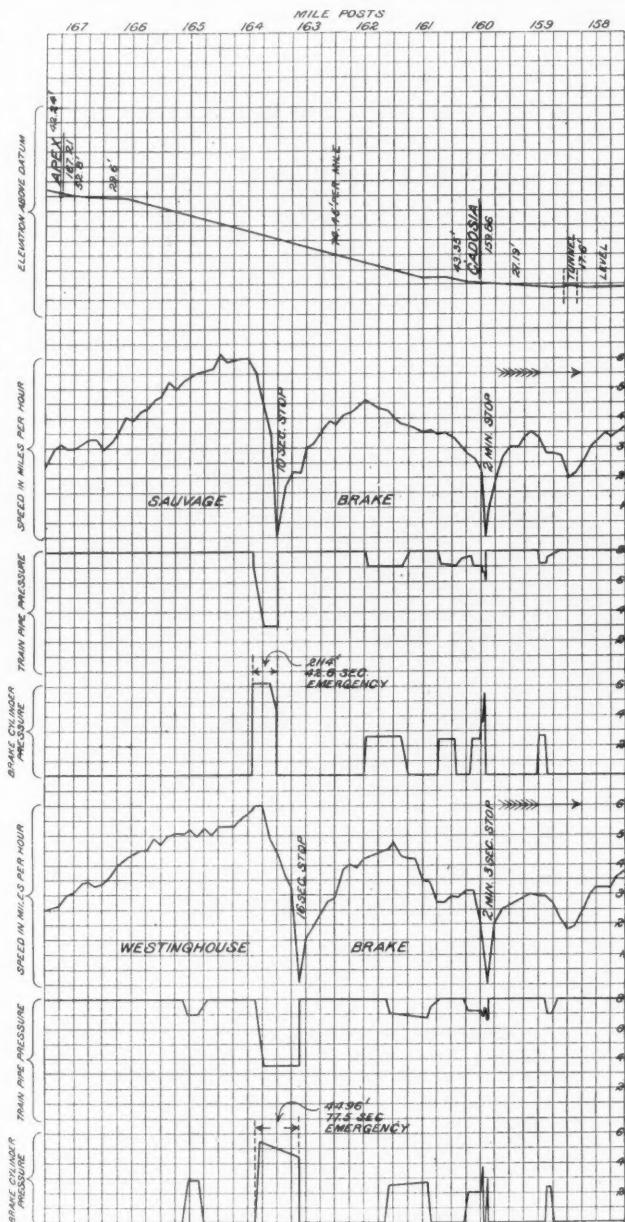
Taking up these tests in detail, it is seen that, grouping the three runs of August 29, September 2 and 8, there were nine emergency stops made from an average speed of 47.68 miles per hour, and that the average length of stop was 1,364.6 ft. The

average record for the tests of September 6, 10 and 12 is for speed 50.88 miles per hour and for distance 1,819.3 ft.

This shows a loss of 6.27 per cent. in speed and a reduction of 25 per cent. in distance for the Sauvage brake. If, however, we consider the length of the stop to represent the actual amount of work done, and that this varies with the square of the velocity, it will be found that there is an increase of efficiency of 18.3 per cent.

It must be borne in mind, however, that in this comparison the ordinary brake was working with a leverage that results showed, as will be indicated later, is impractical for regular service work.

If now we compare the runs of August 29 and September 2 and 8 with those of August 31, we have, as before, for the former an



Specimen of Report Diagram of Speed, and Brake Events in Sauvage Brake Tests.

average speed of 47.68 miles per hour, with an average distance of 1,364.6 ft. run after the application of the brakes, while for the run of August 31 the average speed was 46.37 miles per hour and the distance 2,221 ft. This shows an increase of speed for the Sauvage brake of 2.82 per cent., and a decreased average distance of 38.56 per cent. Applying the principle of squares of velocities to this series, we find that the increased efficiency of the Sauvage brake is 43.89 per cent.

This is a fairer comparison on the basis of service work than the preceding one, in that both brakes were operated with the regular leverages that are used in service.

On September 8 and August 31 the conditions of operation were most nearly identical. September 8 was the only trial of the Sauvage brake in which all cars were equipped with it; the weather

conditions were the same, both brakes were working on the standard leverage, and the weights of the two trains, including engine and tender, were 961,600 lbs. for the Sauvage and 1,051,000 lbs. for the ordinary.

Taking up the stops in detail, they were as follows:

Milepost.	Sauvage		Ordinary	
	Speed, miles per hr.	Distance in ft.	Speed, miles per hr.	Distance in ft.
163	60	2,114	60	4,496
150	44	679	42	1,202
113	44	898	38	1,088
102	48	1,050	45.5	2,099

In this there was a saving of distance on the part of the Sauvage brake in actual distance at

Milepost 163...52.98 per cent. Milepost 113...38.45 per cent.
Milepost 150...43.51 per cent. Milepost 102...50.00 per cent.

If we equate on the basis on the squares of the velocities, the saving of distance on the part of the Sauvage brake was at

Milepost 163...52.98 per cent. Milepost 113...17.48 per cent.
Milepost 150...51.09 per cent. Milepost 102...55.06 per cent.

This is an average of 49.39 per cent., with a minimum of 38.45 per cent., from which it seems safe to conclude that, at the same speeds, the Sauvage brake will stop a loaded train in from 40 to 50 per cent. shorter distance than the ordinary. In other words, it will require from 1.66 to 2 times as great a distance in which to stop a train with the ordinary than it will with the Sauvage brake.

The shorter the train, the greater was the distance run. This is quite in accord with the expected in that, with a heavier train fully braked, the unbraked weight of the locomotive forms a smaller percentage of the whole in a long than in a short train. In other words, there is a greater amount of resistance in the train to effect the engine retardation.

The air consumption in these tests was about the same in the case of the two trains. There was a certain varying amount of leakage from the train pipe at all times, and this was a burden that tended to increase the percentage of the brake using the smaller quantity and decrease the proportional difference between the two.

The total number of brake applications in the whole series was 154 for the Sauvage and 172 for the ordinary, or an average of 39.7 for the Sauvage and 38 for the ordinary on the southbound runs and 35 for the Sauvage and 32 for the ordinary on the northbound.

In order to ascertain approximately the air consumption on the two types of brakes when the special and emergency stops were eliminated and nothing but the working service conditions obtained, two runs were made between Norwich and Middletown, 146.95 miles.

The elapsed times between terminals were 6 hrs. 14 min. 15 sec. for the ordinary brake, and 6 hrs. 53 min. 30 sec. for the Sauvage train. Of this 5 hrs. 13 min. 15 sec. and 5 hrs. 40 min. 51 sec. were occupied in running, respectively. The pump stroke counter registered 18,701 strokes for the ordinary brake and 10,558 for the Sauvage train. There were 54 distinct brake applications with the former and 37 with the latter. Taking the averages of the time and amount of train pipe reduction for the runs, they were a reduction of 12.25 lbs. throughout a period of 37.64 minutes for the ordinary and a reduction of 8.73 lbs. for 24.93 minutes for the Sauvage brake. If these are compared on the basis of the products of these two sets of figures, it will be found that the train pipe reductions were but 47.10 per cent. of those used on the ordinary brake train.

The air consumption, with allowances for leakage, amounted to 11,969 strokes of the pump with the ordinary brake and 5,608 strokes with the Sauvage brake, making the latter 46.85 per cent. of the former.

If it is assumed that the cylinder capacities of the engine, tender and passenger car brakes are equivalent to those of five milk cars the relative capacities of the two trains would be as 15 to 14. Dividing the strokes of the pump required for brake applications by these figures and comparing, it will be found that the Sauvage brake required only 50.25 per cent. the amount of air per car in order to do the braking that was required by the ordinary brake.

It is, of course, unsafe to make broad generalizations from single tests, especially where there is a chance for a variation in the handling of the brake and the exigencies of the run; but it does seem fair to state that a loaded train can be handled on a much lower air consumption with the Sauvage than with the air brake as ordinarily applied. Whether this saving will range from 35 to 50 per cent., as these particular runs would seem to indicate, remains to be proven by future use and investigations.

One criticism may, however, be forestalled, and that is regarding the fact that the number of applications were fewer and the periods shorter. Both of these were due to the superior action of the Sauvage brake. Fewer applications were required in order to keep the train under control because a higher speed was permissible on the grades, while the greater efficiency of the brake, when applied, reduced the period during which a brakeshoe pressure on the wheels was required.

There is one final point to which attention should be called, and that is the effect of the two brakes on the wheels. In this the effect of the ordinary brake with the standard leverage may be disregarded. When the cars were worked with the high leverage it was feared

that there might be trouble on account of the sliding of the wheels. The engineer was, therefore, instructed to use and did use sand on all of the special stops with the ordinary brake and high-leverage brakes except on those of September 6, and on this day the most serious sliding took place on a clean, dry rail; whereas no sand at all was used on any of the stops with the Sauvage brakes. It is, therefore, evident that the ratio of effectiveness of the Sauvage brake in comparison with the ordinary would have been much greater on all of the comparisons with the exception of that of August 31, had the conditions of application of the brakeshoes to the wheels been the same.

Even as it was, there was a serious amount of flattening according to the railroad reports as the result of these brake applications. In all, 28 pairs of wheels were reported to have flattened with the high-leverage ordinary brake, and but four pair when the Sauvage brake and the high-leverage connections on the test of September 11, and none under current conditions. Since that time no wheels have been flattened in the regular service using the Sauvage brake.

There has been no opportunity to investigate as to the exact reason for this, and a cause can, therefore, merely be suggested.

In the case of an ordinary brake in an emergency application the whole of the brakeshoe pressure is put upon the wheel in the form of a blow. With the Sauvage brake, on the other hand, the regular cylinder takes up all of the slack and puts on a pressure that causes the shoes to adjust themselves to the wheel. Then the second cylinder puts on the extra pressure, which thus takes on the form of static load instead of a blow, with the result that the effect on the wheels is not sufficient to bind and skid them.

The conclusions to be drawn from a consideration of this work is that the Sauvage brake is especially valuable in the case of loaded cars, and the situation may be summed up in the statement that the advantages possessed for the Sauvage brake are not purchased at the expense of any modification in the present equipment that will require a change in the method of operation or the parts in use. The same triple valves, brake cylinders, levers and connections can be used as in the standard equipment. If these are already in position on the car they need not be moved, for the new cylinder can readily be put in position beside or ahead of them, as in the case of the milk cars that have been tested.

The advantages offered by the device are that a brakeshoe pressure proportional to the weight on the wheels can be obtained, and this on about the same consumption of air that obtains for the ordinary brake working on empty car-wheel loads, and that for ordinary handling the air consumption is materially less. In short, it adds efficiency to the present brake without any additional complication and without any change in the standards of construction or operation of that to which railroad employees have been trained.

Railroad Decisions in March.

The following decisions in railroad cases were handed down by the United States Supreme Court and the Federal courts during March:

Effect of discrimination clause of commerce act on railroads authorized to mine and sell coal.—The Interstate Commerce Commission having construed the prohibition of the interstate commerce act against rebates and discrimination to be inapplicable to the freight rates charged by interstate carriers authorized to mine and sell coal by legislation existing at the time of the enactment of the act, and this construction having been long followed in practical execution, will be regarded as read into the interstate commerce act by its re-enactment by Congress without alteration in this particular. But this construction will not avail a carrier not authorized to act in this dual capacity at the time of the enactment of the interstate commerce act, and which buys coal on the market and transports same at a price insufficient to yield its published freight rates after deducting the cost of purchase and delivery. *New York, New Haven & Hartford Railroad Co. v. Interstate Commerce Commission*, 26 Sup. Ct. Rep. 373.

Exemption from taxation.—The antebellum charter of the Cheraw & Darlington attempted to confer a tax exemption privilege on that company. After the war the authorities of South Carolina, in disregard of the provision, assessed the property for taxation and attempted to collect the same. This effort was resisted and culminated in a decision of the Supreme Court of the United States sustaining an injunction against the levy and subsequent proceedings for its enforcement. This decision sustained the validity of the exemption in the charter. The suit was participated in by the State through its Attorney General, and the decision was accepted and respected by the taxing officers of the State until the consolidation of the Cheraw & Darlington with the Atlantic Coast Line terminated the privilege. In 1900 the Legislature passed an act authorizing the levy of back taxes on this property for the ten years before the consolidation, these to be collected from the Atlantic Coast Line. This has resulted in another decision, in which the finality of the earlier decision sustaining the validity of the exemption is asserted,

and this conclusion is supported most strongly by the conduct of the State of South Carolina in its attitude of acquiescence in the decision for more than twenty-five years. *Gunter v. Atlantic Coast Line Railroad Co.* 26 Sup. Ct. 252.

School children's rates.—The Texas statute requiring street railroad companies to issue half-fare tickets to children is held not to impair the obligation of contracts with cities in that State fixing the rates which were entered into after the adoption of a constitutional provision giving the Legislature control of all privileges granted by it or created under its authority. *San Antonio Traction Co. v. Altgelt.* 26 Sup. Ct. 261.

Conditional right-of-way deeds.—A deed of right of way on the express condition that the railroad company maintain a passenger station and stop certain of its trains at the station to take on passengers, failing in which the land will revert to the grantors, will be taken to merge a previous contract between the parties which did not provide for the reversion, and the railroad company having failed to perform the condition cannot in a court of equity ask to have the deed changed to conform to the prior contract. *Gray v. Chicago, Milwaukee & St. Paul Railway Co.* 140 Fed. Rep. 337.

Right-of-way contracts.—A contract made by a land owner granting a railroad company "the full and free right of way of the width of fifty feet" through his land and covenanting to execute a deed, when required, conveying the land in fee simple, vests the company with a right of easement only prior to the execution of the deed, and hence a lease by the railroad company of a portion of the land thus held will confer on the lessee no right to enter upon such land to operate for and take away oil and gas therefrom. *South Penn Oil Co. v. Calf Creek Oil & Gas Co.* 140 Fed. Rep. 507.

Railroad construction contract.—In a contract for railroad construction a provision that "solid rock" shall include "all other material which in the judgment of the engineer cannot be moved without being blasted" will be given a reasonable construction with reference to practical railroad construction; and, thus construed, the term may include material having the characteristics of solid rock, but the blasting of which is not practical, even though it could be removed without blasting. In such a contract a penalty clause is also to be liberally construed. Thus a penalty of \$100 a day for delay beyond the time fixed for the completion of the road was held not operative after the railroad company took possession of the road for commercial purposes, though the road was not completed according to contract. *Fruin-Bambrick Construction Co. v. Ft. Smith & Western Railway Co.* 140 Fed. Rep. 465.

Excessive speed and failure of signals at crossings.—A person in full possession of his senses of sight and hearing who deliberately walks upon a track in front of an approaching train in broad daylight at a point where there is an unobstructed view of the track for a quarter to a half mile, is guilty of such a reckless disregard for his own safety that there may be no recovery for his death by being run over at the crossing, though the train is run at an unlawful speed and without sounding the statutory signals. *Gipson v. Southern Railway Co.* 140 Fed. Rep. 410.

Foreign Railroad Notes.

The International Sleeping Car Co. announces that it will add to its limited trains a "Simplon Express" between Calais and Milan. This train will leave Calais at 2.55 p.m., receiving passengers from the trains leaving London at 11 a.m. It will arrive at 6 the next morning at Lausanne, at 9.55 a.m. at Domodossola, and at 12.35 p.m. at Milan—a considerable reduction of the present shortest time between London and Milan.

The waste of war has sensibly reduced the available rolling stock of the Russian railroads, which was insufficient previously, and the whole country is reported suffering from the inability of the railroads to handle their traffic. Under these circumstances the Minister of Transportation was preparing to order rolling stock from foreign works. The Russian car and locomotive builders protested. Owing to strikes and other disorders they claimed that they

were suffering great losses. They interested the Ministry of Commerce and Industry, and on its representations it is said that no orders will be given to foreign works. As the Russian works are of limited capacity, and as the railroads probably need fully double their usual annual requirements, it seems to an outsider as one additional calamity for Russia, though perhaps this is an unavoidable one.

A Reinforced Concrete Elevated Roadway.

The reinforced concrete approach to the viaduct over the tracks of the Chicago, Rock Island & Pacific and the Atchison, Topeka & Santa Fe at Walnut avenue, Oklahoma City, Okla. T., embraces some interesting features. The main part of the structure is on Walnut street. It is 340 ft. in length, of which 112 ft. consists of fill between reinforced concrete retaining walls, the balance being made up of six girder spans of 26 ft. each, two of 25 ft. and one of 22 ft. On Main street joining this at right angles at a point about a third of its length from the tracks is a similar structure, having a total length of 230 ft., consisting of 100 ft. of fill confined by concrete retaining walls and five girder spans of 26 ft. each. Thus it will be seen that the combined approach forms a roughly T-shaped structure one-tenth of a mile long.

The roadway on Main street has a uniform grade of 6 per cent., while on Walnut street a maximum grade of 8 per cent. was found



Reinforced Concrete Elevated Roadway at Oklahoma City.

necessary. At the point where the approach joins the viaduct proper the roadway is about 23 ft. above the ground level. The Kahn system of reinforced concrete was used throughout. The roadway is uniformly 24 ft. in width and consists of 4 in. of asphalt pavement laid on a 6-in. concrete slab, reinforced with $\frac{1}{2}$ in. x $1\frac{1}{2}$ in. Kahn bars 10 in. on centers. Bars of the same section 6 ft. long were inverted in the top of the slab over the center girders.

The roadway is carried on three lines of concrete girders 11 ft. apart supported in turn by three rows of columns. Small transverse stiffening beams 20 in. deep connect the girders at the columns and act as transverse bracing. The outside girders are 20 in. x 26 in., the central one is 2 in. deeper. All girders are reinforced with two $1\frac{1}{4}$ in. x $3\frac{1}{4}$ in. and two 1 in. x 3 in. Kahn bars the full length of the span and two $1\frac{1}{4}$ in. x $3\frac{1}{4}$ in. bars 12 ft. long. Two 1 in. x 3 in. bars are inverted over the columns. In addition, the middle girder has a 1 in. round truscon bar, which is bent up over the supports.

The columns are 20 in. square at the top and are battered one-quarter of an inch in a foot on all sides. They are reinforced with four $\frac{3}{4}$ in. x 2 in. bars. The railing is also of concrete 6 in. thick, reinforced longitudinally with $\frac{1}{2}$ in. round rods and vertically with $\frac{1}{2}$ in. x $1\frac{1}{2}$ in. bars. Projecting stiffening ribs 6 in. wide placed at 6 ft. 6 in. center to center help to support and stiffen the rail.

Foot passengers mount the structure by means of two reinforced concrete stairways starting beneath the roadway and coming up on either side in the third panel from the viaduct proper,

which is reached by 6-ft. sidewalks supported on cantilever brackets placed at 7 ft. centers. These brackets are 10 in. wide and are reinforced with two $\frac{3}{4}$ in. x 2 in. bars on the tension side and a $\frac{1}{2}$ in. x $1\frac{1}{2}$ in. bar on the compression side. The sidewalk slab is 4 in. thick reinforced with $\frac{1}{2}$ in. x $1\frac{1}{2}$ in. unsheared bars.

The stairs are built with longitudinal strings and a smooth underside. They have a $\frac{1}{2}$ in. x $1\frac{1}{2}$ in. transverse bar in each tread. They are built in three flights, the longer reaching from the roadways to a platform about 7 ft. above the ground; the shorter runs from these platforms to a common landing beneath the roadway, from which a few steps lead to the ground. Separate posts support the platforms.

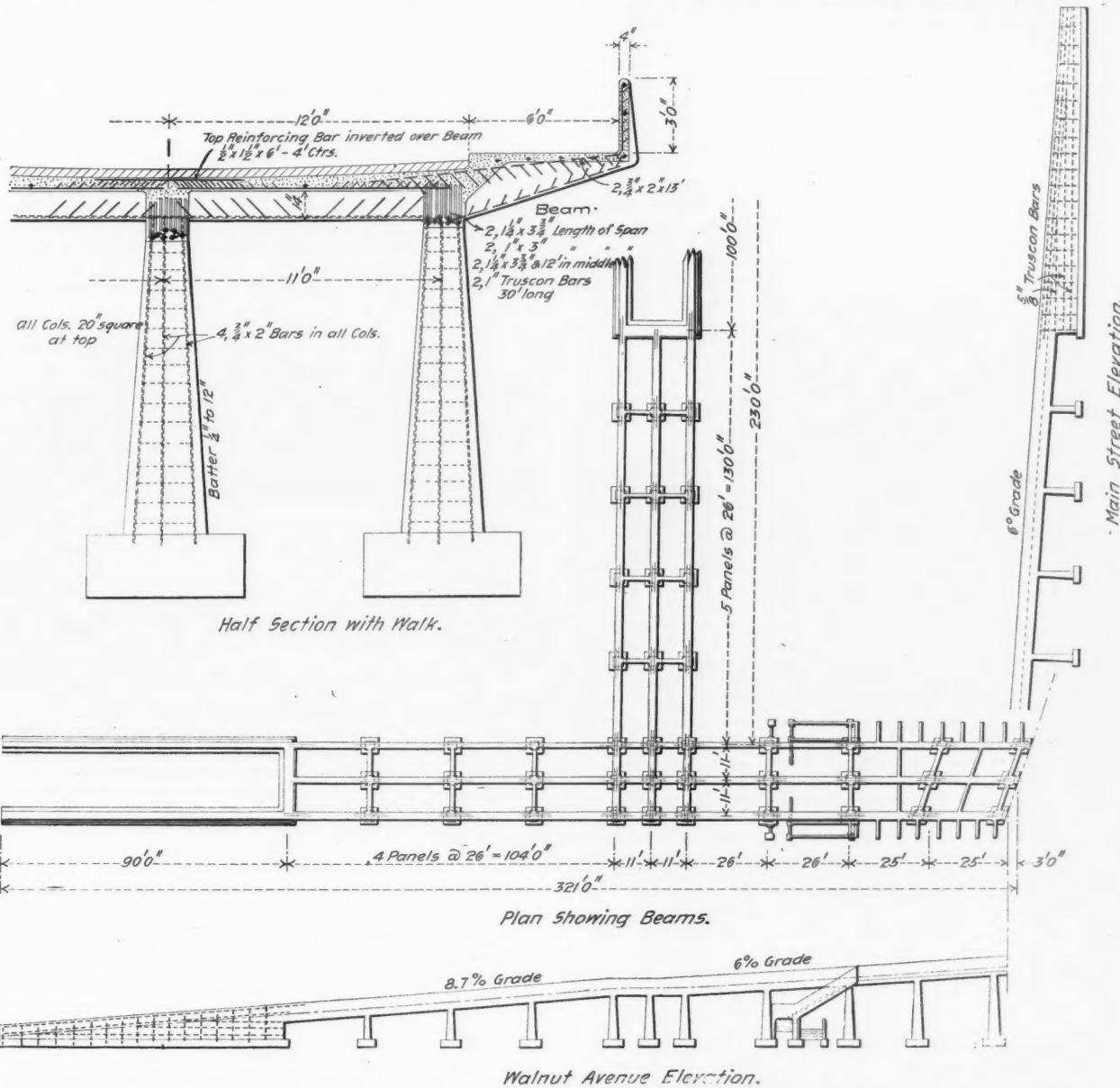
The retaining walls have the same section as the hand rail above the roadway. Below the street level they widen out with a batter of 1 in. to 1 ft. on the outside and twice as much on the inside.

In the structure there were used 1,200 cu. yds. of concrete and

Machine Shop Practice.*

(Concluded from page 314.)

The advantages of a motor-driven shop over a belt-driven one are now so universally accepted that no argument is necessary. All the technical magazines have had frequent articles on the special advantages of electrically driven shops toward getting cleaner, better lighted, easier handled shops and it would be but wasting time to repeat the arguments. The electric motor presents the opportunity of obtaining the close variations in speed that are so conducive to economy, and there are many different systems which will give, more or less accurately, the speed changes required. Until quite recently the multi-voltage system of control was undoubtedly the best, but owing to the great improvement or rather specialization of motors this system may probably be replaced entirely by the use of field controlled motors giving wide variations of speed.



Reinforced Concrete Approach and Elevated Roadway Over the Tracks of the Chicago, Rock Island & Pacific and the Atchison, Topeka & Santa Fe at Oklahoma City.

37 tons of steel. The total cost was \$15,600, \$3,000 of which was for the asphalt paving. This is less than the estimated cost of a steel structure with wooden flooring and having an approach from Main street only. The asphalt paving was rolled with a nine-ton steam roller and the completed structure tested with a 20-ton moving load without deflection.

The approaches were built under the superintendence of W. C. Bourk, City Engineer, by the John Gilligan Co., of Falls City, Neb., in accordance with plans prepared by the Trussed Concrete Steel Co., of Detroit, Mich. The latter company furnished the steel reinforcement.

Although many engineers approve the use of the motor, yet they restrict it to the larger tools, but if it holds good for the larger tools why not also for the smaller? Do not exactly the same arguments hold? The value of the introduction of the motor was the reduction in the cost for labor. If any tool is driven by use of belt-driven cone pulleys, what difference does it make in the output of that machine whether the countershaft is belt-driven or motor-driven? None whatever. It may readily be proved that for any tool on which variation in speed is required, that the installation

*Paper by G. M. Campbell, read before the Mechanical Section of the Engineers' Society of Western Pennsylvania.

of an individual motor drive with 10 per cent. speed increments will be an economical investment. The time is coming when practically every metal working tool, where speed changes or changes in material are required, will be, in an up-to-date machine shop, equipped with its own individual motor and at practically the price of the present tools. It is usually claimed that a group-driven system of motor drive is much cheaper than the individual motor drive, but such was not the experience in the shops of the Lake Shore Railroad, as was shown in an exhaustive report by the committee of the Master Mechanics' Association and published in their proceedings for the year 1903. An extract is given herewith.

Cost for Group Driving.		
11 group motors	\$4,550.00	
Wiring 11 motors at \$18.30	201.30	
Wiring 202½ H. P. at \$4.80	972.00	
Countershaft, line belt, pulleys, etc.	6,667.00	
Belting	3,881.00	
	\$16,271.30	
Estimated Cost for Individual Drive.		
103 motors	\$12,340.00	
Wiring 103 motors at \$18.30	1,884.90	
Wiring 242½ H. P. at \$4.80	1,164.00	
	\$15,388.90	

"This result may seem surprising, but it is even more favorable to the direct-driven estimate than it appears. The roof construction must be appreciably heavier when it is expected to support countershafting than would be the case if simply required to cover the building. Additional members must be incorporated, but this expense we are not in a position to estimate at present. Then no charge is made against belt-driven tools for belt shifters and the cost of applying the belting, which for 103 tools is quite an expense." On the other hand the speaker thinks the estimate for the individual drive is somewhat low both in capacity of motors and cost of wiring. The whole report from which the above extract is taken is an excellent one and worthy of close inspection by anyone interested in shop equipment.

One argument often brought up against the old belt-driven shop was the great waste of power, and the same is brought up against the use of individual motors as against group driving on account of the lower efficiency of small motors, but the argument is not worth considering when the total amount of the power consumed is taken account of. The cost of power is very rarely 2 per cent. of the cost of the output in shops of any size. Suppose by the strictest economy 50 per cent. of the cost of power could be saved, yet the net saving would be only 1 per cent. During the year 1904 the total cost for power at the Pittsburg & Lake Erie shops was slightly over one-half of 1 per cent. of the cost of the labor and material.

Some information concerning the motor equipped shop of the P. & L. E. R. R. at McKees Rocks may be of interest. The shops are compactly situated and consequently direct current could be used to advantage; the voltage in use is 250. For machine work, the multi-voltage system of drive is used and with excellent results. The voltages vary by steps of 40 from 40 to 240, with intermediate and additional steps obtained by means of field resistance. The controllers in use have 21 steps in forward motion, giving approximately 10 per cent. increments. Individual motor drive was carried to a much greater extent than in any shop previously put up, but experience has not shown that any mistake was made in so doing. In the machine shop only one small group of tools is driven from shafting. All the others have individual motors. The tools in the group above referred to are such tools as drill grinders, polishers, bolt threading machines, etc. In the wood working shops, however, group driving is the rule; individual motors are used only on the larger machines; in general in machines of this class no change in speed is required and therefore group driving is entirely satisfactory.

One excellent feature of the electric installation is the entire absence of exposed wiring, and yet every foot of the floor of the big machine and erecting shop, 172 x 530 ft., is accessible. This is accomplished by running a tunnel 3 ft. 6 in. by 4 ft. the full length of the shop, and from it branch ducts 4 x 12 in. from side wall to side wall every 5 ft. 6 in. These latter were made part of the floor and were put in practically without expense. All the wiring in these ducts was put in after the floor was put down, lored conduit being used.

In order to protect the machine, not the motor, the motor is controlled through a fused switch and also a circuit breaker. Up to date there have been only three cases where the machine gave way, though all the machines have had severe work. The weak parts, chiefly gears, were replaced in these instances by heavier material, and no further trouble is expected. In obtaining speed variation, in a large number of machines it is impossible to obtain it entirely by the motor. Speed ranges of 50, 75 or 100 to 1 are not at all infrequent, such, for example, as changes given by the old triple or quadruple geared lathes. This is, in an electrically driven tool, taken care of by obtaining, say a 3 to 1 variation in the motor and the necessary number of change gears, each increasing the speed in proportion of, say 3½ to 1. A very common method of obtaining these changes is to use sliding or rocking gears. This the writer considers bad design; nothing but clutches

should be used, for otherwise it is impossible to change from one gear drive to another except when the machine is idle, and then on the heavier machines only with difficulty, whereas with clutches the change can be made without stopping the machine. In the P. & L. E. R. R. equipment this point was absolutely insisted on despite the severe opposition of every tool maker. Magnetic clutches for the reciprocating tools were not used, as it was considered that the improvement in results would not be sufficient to warrant the expense, and also the clutches at that time were in a state of development. Better results may now be obtained and probably at lower cost.

The complete list of all motors installed numbers 83. This list of motors shows sizes as follows:

No.	Rating.	Total, H. P.	No.	Rating.	Total, H. P.
1	2	2	13	15	195
6	3	18	3	20	60
6	4	24	7	25	175
11	5	55	3	35	105
3	6	18	1	45	45
16	7½	120	1	60	60
1	9	9			
10	10	100	83		
1	13	13			1,000

It should be noted that the rating is for full speed and voltage, not the actual horse-power obtainable at all times and not the horse-power required by the machines. The horse-power rating for the variable speed machines would be only 40 to 50 per cent. of the motor rating. The other motors around the plant would add about 450 h.p. and the cranes about 250 h.p., bringing the total motor rating up to about 1,700 h.p. Of the 83 motors, 75 are used for individual drive and eight for group driving; five of these eight being in wood-working shops; 27 are constant speed and 56 variable speed motors. The total cost of these 83 motors was \$20,275, or an average cost of \$244.50, exclusive of mounting. The same motors could now probably be bought from 15 to 25 per cent. cheaper. The average horse-power of these 83 motors is 12.05.

During the year 1904, the average horse-power taken by all machine tool motors was about 200 during working hours, but all the tools listed above were not in operation. The average power consumption at present is about 300 h.p., or about 30 per cent. of the horse-power rating of the motors. During the year 1904, the average power consumption of the machine tools was 17.3 per cent. of the output of power house; it was 38.71 per cent. of the total electric power; lighting was 24.9, heating motors 23.78 per cent. The electric power consumption of the machine tools including cranes and blast fan was subdivided as follows:

	Per cent.
Variable speed tools.	39.71
Constant speed tools	26.80
Blast fans	28.44
Cranes	5.05
Total	100.00

The total cost of power for the machine tools, including the cranes, was \$2,662.66; this does not include the maintenance of motors.

In addition to the shops being well equipped with motor-driven tools, there are at present in service seven cranes from 120 ton to 7½ ton capacity. Three more will be added shortly.

The capacity of the power house for electric work is 600 k.w. full load rating, or 750 k.w., with 25 per cent. overload. There is space for one additional generator of 150 k.w. capacity.

The following few items are given concerning speeds of cutting. These are not given as maximum and are not special tests, but are every day practice, as previously stated.

P. & L. E. R. R. Co.—McKees Rocks Shops.					
Sample Cutting Speeds.					
Machine	Wt removed	Speed	Material.	Remarks.	
No. 10 Lathe	2.63	106	Cast Iron.		
10 "	2.33	44	Steel.		
16½ "	1.69	170	Steel.		
13 "	3.43	43	Steel.		
20 "	4.2	54	Wrought Iron.		
14 Wheel lathe	6.3	13.2	Steel.		
23 Wheel lathe	5.3	15.5	Steel.		
51 Planer	3.2	30	Cast steel.		
52 Planer	18.3	29	Cast Iron.		
62 Sharpener	2.03	120	Brass.	60 strokes, min.	
39 Drill	0.52	74.5	Wrought Iron.	1½-in. drill.	
147 Drill	0.88	53.9	Wrought Iron.	1¾-in. drill.	
33 Boring mill	1.1	59.5	Steel.		

Railroad shops are in general repair shops, so the weight of metal removed is not at all remarkable, compared to many tests which have been reported.

To show the excellent results obtained in the new shops the following figures may be noted. The shops were opened in February, 1904, but were not in full operation until some months later. It, of course, took some time to become used to new conditions, so that results for year 1905 would probably show a higher increase over year 1903.

	1904.	1903.
Locomotives repaired	145	64
Locomotives built	10	None.
New fireboxes	21	5
Cost of labor	\$236,871	\$216,472
Increase of only	9.5%	...
Credit for outside work	\$61,516	\$4,800

The force of men is now 25 per cent. more than during 1903.

but the output is very considerably greater. Formerly five to seven locomotives were overhauled per month, now from 14 to 20. Very much of the increase in number is due to the repairing of locomotives for other roads—Erie, Lake Shore, Pennsylvania and Union R. R.

The new shops are considered an excellent investment despite the heavy first cost, and it is estimated that they will have paid for themselves, including first cost and interest, in ten years or less.

The McCord Draft Gear.

A high capacity draft gear embodying an entirely new principle is shown in the accompanying illustrations. It is not a friction gear, and although friction is an unavoidable element of its operation, it is in no way essential thereto. The gear is designed on the theory that the proper way to absorb the shock of a blow is through an elastic medium rather than by means of frictional surfaces, which at the very least require a certain amount of power to operate, the work of which is necessarily transferred to the draft lugs and underframe and absorbed by them. The prin-

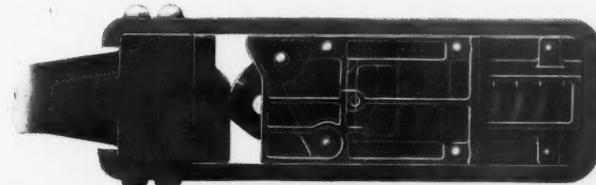


Fig. 1—McCord Draft Gear Showing Position of Lever and Spring When Under no Load.

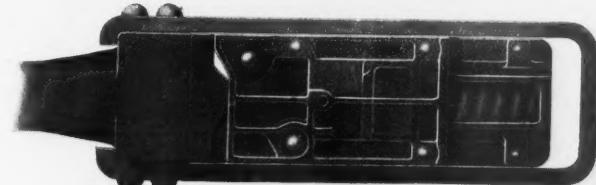


Fig. 2—McCord Draft Gear Showing Position of the Moving Parts Under a Buffering Load of 250,000 lbs.

ciple of elastic resistance to shock is accomplished in this gear by simple arrangement of cam-shaped levers acting on the spring as the drawbar moves, the leverage decreasing as the load applied increases. The final result is to increase about 12 times the capacity of the spring, the gear showing an ultimate capacity of about 250,000 lbs. when solid.

The best idea of the operation of the device is obtained by conceiving the coupler acting against the spring through a lever, and this connection between the spring and the lever so arranged that as the coupler moves the spring is automatically moved out on the lever until at the end of the coupler movement the spring has gained an increased leverage against the coupler of about 12 to 1. In order to get the device into a more compact and practicable form for application to cars, this single-lever effect is obtained by means of two cam-shaped levers, and the variation of the leverage

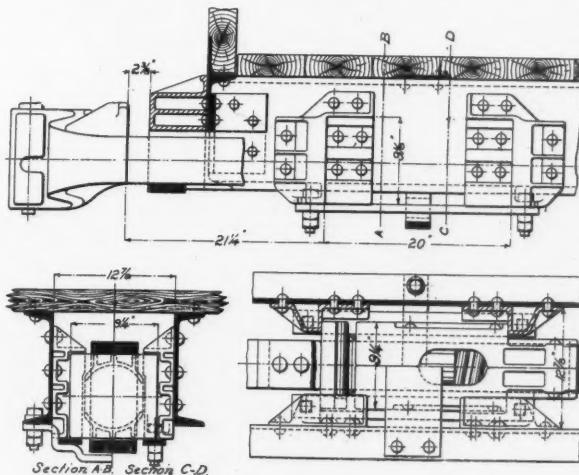


Fig. 5—McCord Draft Gear as Applied to 100,000 lbs. Capacity Steel Car.

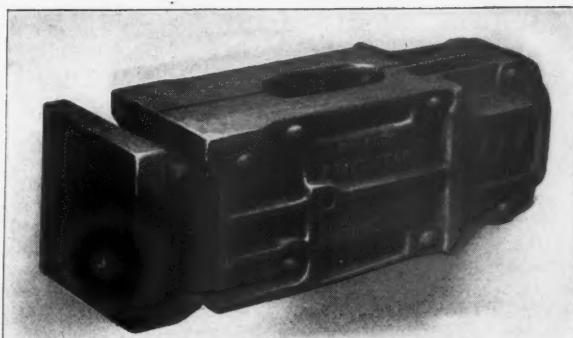


Fig. 3—Perspective View of the McCord Draft Gear.

is secured by shaping these levers so that in rocking one upon the other the leverage is increased in practically the same way.

Reduced to practice the device is extremely simple, consisting of two malleable iron castings forming the casing, a malleable spring cap, two cast-steel levers, a cast-steel front follower and a spring. The shoulders on the malleable casings take the place of a rear follower. The entire device consists, therefore, of six castings, one spring and seven rivets.

Fig. 1 shows the position of the levers and spring of the draft gear assembled in the yoke under no load. Fig. 2 shows the posi-

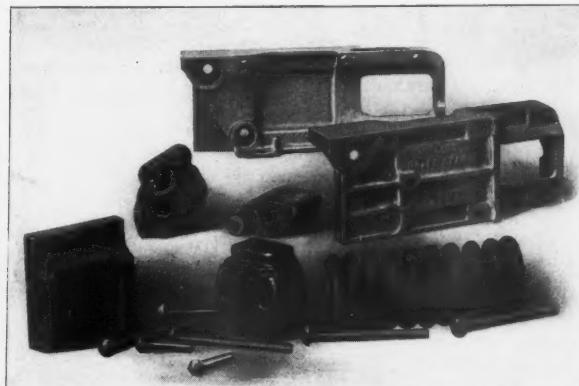


Fig. 4—The McCord Draft Gear Before Assembling.

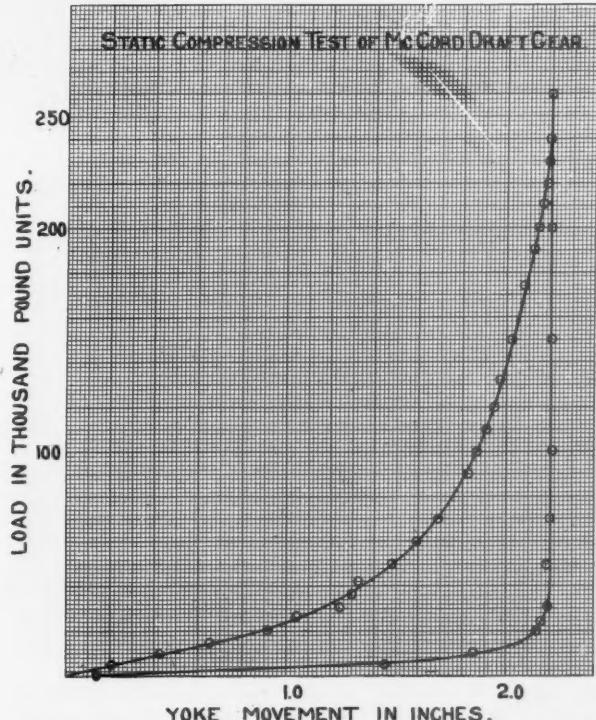


Fig. 6—Diagram Showing the Action of the McCord Draft Gear Under Compression Test.

tion of the moving parts under a buffing load of 250,000 lbs. when the gear becomes solid. Fig. 3 is a perspective view of the draft gear ready to slip into the yoke, and Fig. 4 shows all the parts of the gear before assembling. Fig. 5 is a detail of the application to a 100,000 lbs. capacity steel car. Fig. 6 exhibits the action of the gear under compression test. In this latter, special note should be taken of the relation between the drawbar travel and resistance to load, indicating that ample coupler movement is allowed, to give adequate elasticity to the gear until the load is increased beyond ordinary service conditions and up to present maximum drawbar pulls. After this point is reached the resistance increases very rapidly until the capacity of the gear is exhausted. The release line is almost vertically down to 20,000 lbs. This same vertical release line is obtained at all loads from about 30,000 lbs. up to the capacity of the gear.

Besides the ordinary compression, tension and drop tests, in which this gear is said to have shown as good if not better results than any other, the device has been most thoroughly tested for over two years under the most severe service conditions. The type shown here is suitable for standard steel sill spacing and is interchangeable with many of the high capacity gears now in use.

A special design embodying the same mechanical features, but of 125,000 lbs. capacity, is made, which can be applied to the M. C. B. sill and draft lug spacing for wooden cars.

The gear is made by McCord & Company, Chicago, and is called the "McCord" draft gear.

A New Design of Metal Saw.

The High Duty Saw & Tool Co., Eddystone, Pa., has furnished to the American Locomotive Company its latest designed machine for high duty sawing. It is made primarily for sawing 13 in. square, 0.60 carbon steel billets into convenient lengths for forging into locomotive driving axles, but heavy irregular shaped pieces such as forgings and castings can likewise be handled by the machine by the temporary removal of the special appliance fitted to the machine and shown in the illustrations for handling billets. The massive vise, with its supplementary table for the firm holding of the heavy axle billets, is a noticeable feature of the tool. The machine weighs about ten tons. The "Tindel" high duty saw blade with which the machine is equipped is 48 in. in diameter by $\frac{5}{8}$ in. in thickness, and has 76 high-speed steel cutters spaced on alternate sides of the blade. The blade cuts to a depth of 16 in. The machine is of high power, with an initial drive of 20 h.p. The bearings of the main driving shaft are provided with phosphor bronze bushings. The spindle is a high carbon steel forging running in a solid tapered phosphor bronze bushed bearing 30 in. long. To insure rigidity the ordinary split bearing is avoided, the arbor seat being cast solid on the carriage. The saddle carrying the spindle has a surface bearing on the bed of the machine of 30 in. by 26 in. and is square locked both front and back. It is gibbed front and back with heavy phosphor bronze taper shoes. Following the "Tindel" system of sawing, no worm gearing is used in the main drive, the power being transmitted entirely through straight gearing. The feed, however, is by roller friction discs transmitted through a worm and worm wheel to a heavy screw engaging in a long bearing bronze nut in the back of the saddle. The friction feed is preferred as it gives a better gradation of feed than can be accomplished through gearing.

The housing and bed plate of the machine are cast in one piece to insure rigidity. This plan also affords opportunity for affixing the massive vise and supplementary table by large bolts so that the utmost rigidity of the holding appliance is obtained, it being of prime importance in high duty sawing that there be no vibration or spring of the material in cutting. Both vise and supplementary table are removable, leaving the bed plate of the machine available for such shapes as steel castings, forgings, etc. It adds much to the effectiveness of high duty sawing to lubricate and keep the saw cutters cool. For this purpose a plentiful supply of drilling compound is pumped in a steady, liberal stream into the kerf by a rotary pump affixed to the machine and operated by a small belt from the main driving shaft.

The machine is designed for a minimum feed of $\frac{1}{2}$ in. per minute up to a maximum of $1\frac{1}{4}$ in. The periphery speed of the saw blade is in two steps, 35 ft. and 50 ft. p.m. An automatic stop is provided so that the depth of cut can at all times be under the control of the operator. Trials of this machine at the High Duty Saw & Tool Co.'s Works, previous to its shipment, showed a cut of 1 in. per minute on 14 in. square, .50 carbon steel billet, without the slightest strain on the machine.

Prof. Hutton's Resignation.

The following is from the *American Machinist* of April 5:

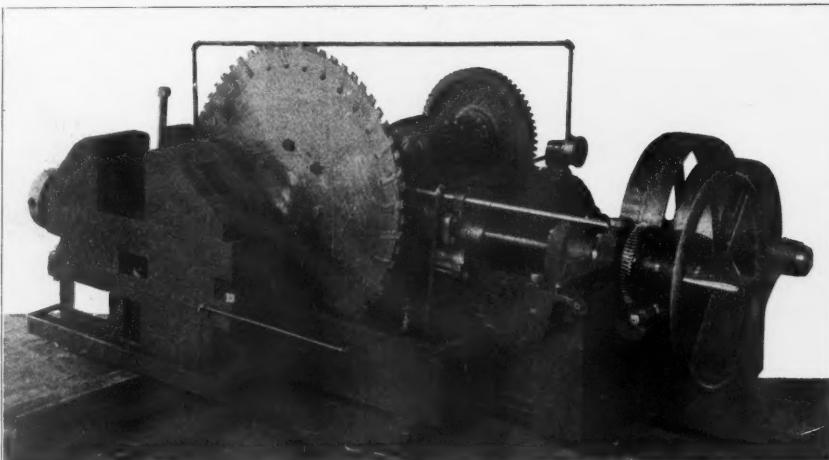
Prof. F. R. Hutton, Secretary of the American Society of Mechanical Engineers, presented to the council at its meeting in January a letter of resignation, the work connected with the conduct of the society's business having increased to such an extent that it seemed to him impracticable to continue to carry the burden along with his work as the head of the department of mechanical engineering of Columbia University. This resignation was not accepted, but action upon it was deferred to give opportunity for conferences with absent members of the council and others. It was later proposed that the services of Professor Hutton be retained for the conduct of meetings and for the performance of other functions for which he has proven his exceptional fitness; the society employing another man to attend to and supervise the detail work of the secretary's office and to be the business manager; this last-mentioned man to have the title of Secretary, and Professor Hutton some such title as Honorary Secretary.

This plan was approved by the council at its meeting of March 27, and a special committee was appointed to select the new man and to rearrange the methods of the office and its personnel, if necessary, in order to institute the new regime. In this way the society may for a long time secure the benefit of Professor Hutton's special skill, ability and experience, while at the same time the aim will be to secure an efficient manager for the society's business and routine work, and one who can give much more time to it than it is possible for Professor Hutton to give. It is generally recognized that in the work of building up the society his services during the 23 years that he has been its secretary have been invaluable, and that for the high position the society occupies to-day its members are very largely indebted to him. Professor Hutton's letter follows:

New York Jan. 29.

To the Council of the American Society of Mechanical Engineers:

Gentlemen:—It may be known to some members of the Council that for several years I have had the thought in mind of resigning the Secretarship



A New Design of High-Duty Saw.

of the Society, on the completion of twenty-five years of service. I was first elected in March, 1883. My more recent thought has been that instead of waiting for a merely sentimental period to elapse, which would have meaning to myself alone, I might rather emphasize the more obvious culmination of my service to the Society by withdrawing at the time when the Society shall cross the threshold of its new home in the Engineering Building. It will then have been given to me to have wrought for the Society from the days of small beginnings, when I paid my own office rent and expenses, through the period of rented offices, and of the ownership of the modest home in Thirty-first street and up to the opening of the days of larger opportunity in the splendid surroundings of the new enterprise. It is wise, I am sure, that at the time of this external change the Society should also make the internal change incident to securing as its Secretary one who will and can devote his entire time to the work and development of the Society.

It is well known to you that I have felt that I must owe and pay my first allegiance to the work of my professorship in Columbia University.

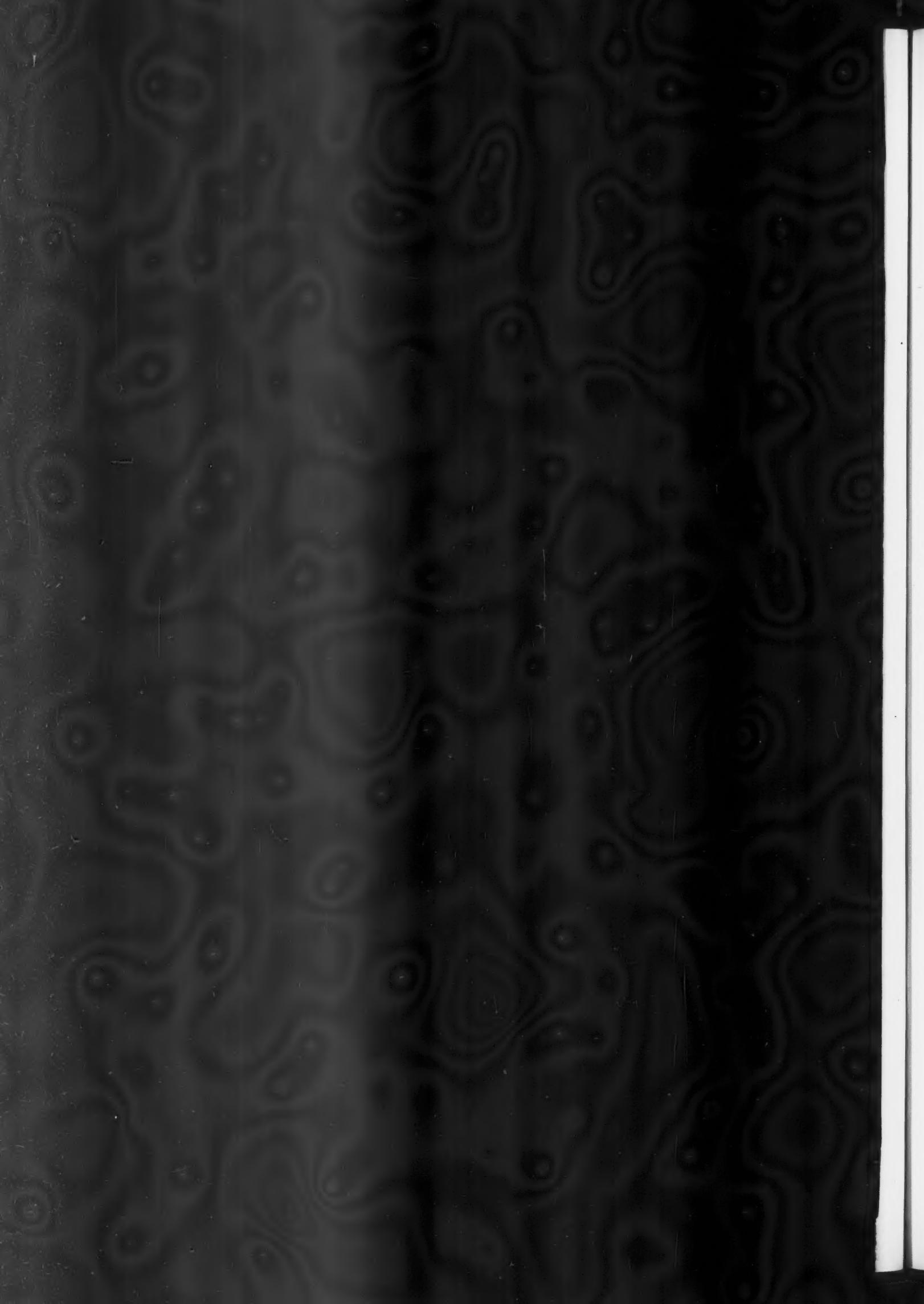
This being the case, the Council should be advised far enough in advance, so that the least embarrassment may be entailed by my withdrawal. I have therefore thought it best to present this formal letter at the first meeting of the year, and to ask by it that proper action may be taken looking to the question for the future which it raises. I ask that I may be relieved of the duties of the Secretarship at the end of the current society year, or at such other time thereafter as the Council may see fit to have this resignation take effect.

It would be my wish and preference that no unnecessary or premature publicity be given to the fact of my decision. I seek to avoid having anything like a "fuss" made.

(Signed) F. R. HUTTON, Secretary.

On the State Railroads of Baden only 24% per cent. of the passenger earnings were yielded by the sale of simple one-way tickets, while 21 per cent. was due to round trip tickets, and more than 33 per cent. to mileage books.





GENERAL NEWS SECTION

NOTES.

On March 29 the number of immigrants arriving in New York from Europe was 11,383.

The Atlantic Coast Line has increased by eight per cent. the wages of about 900 station agents and telegraph operators.

It is announced in Montreal that the Grand Trunk Railway is to put up a telephone line from Portland, Me., to Chicago.

Lumber dealers in Minneapolis say that shippers in Oregon and Washington need 5,000 cars more than they can get to ship lumber to Minnesota.

The exports of grain from Philadelphia for the three months ending March 31 amounted to 11,500,000 bushels, the largest three months' business on record.

A roundhouse of the New York Central at Mott Haven, New York City, was damaged by fire on March 31; loss, including damage to several locomotives, \$50,000.

The Chicago, St. Paul, Minneapolis & Omaha has adopted a pension plan and it went into effect on April 1. The plan is similar to that of the Chicago & North-Western.

The readjustment of wages which has just taken effect on the New York, New Haven & Hartford, increases by eight per cent. (average) the pay of about 2,000 yardmen.

R. D. Wood & Co., tried at Philadelphia last week for accepting unlawful rebates on shipments of iron pipe to Winnipeg, were acquitted by the jury, which was out only 20 minutes.

Pennsylvania papers report that officers of the Pennsylvania Railroad who receive house rent, fuel and light from the company are hereafter to be charged for these services, and to have their salaries adjusted accordingly.

Both houses of the Ohio legislature have passed a bill creating a state railroad commission of three members, to be a "strong" commission. At present Ohio has a single commissioner, who does not exercise important functions.

The Norfolk & Western is to establish a large experimental farm near Ivor on its line in Southampton County, Va. Liberal terms will be offered to settlers and contracts have been awarded for the construction of 50 houses.

A conductor and a signalman of the Atchison, Topeka & Santa Fe have been indicted by the Grand Jury at Peoria on a charge of manslaughter for causing a collision between a passenger train and a freight at Chillicothe Ill., in the month of January.

The Commercial Club of Louisville, Ky., has sent to about 100 general passenger agents copies of a list of 35,000 persons, former residents of Kentucky, who have been invited to attend an "old home week" at Louisville next summer. It is expected to gather many more names to send out later.

Those enterprising railroad officers of the West who have sent out missionary trains to enlighten the farmers have stirred even the effete East. The Boston & Maine has equipped a "farming special" train of four or five cars, which is to be sent on a tour through Massachusetts, Vermont, New Hampshire and Maine.

The United States Circuit Court of Appeals, sitting at New Orleans, has granted a permanent injunction against ticket brokers, forbidding them to deal in non-transferable tickets. The suit was begun in May, 1903, and the case has been persistently contested by the brokers, who endeavored to have the injunction confined to the particular issues of tickets which occasioned the suit.

The Federal Grand Jury in New York city has found indictments against the New York Central & Hudson River Railroad and the American Sugar Refining Company for giving and receiving illegal rebates on shipments of sugar to western cities. The rebates are said to have amounted to from two cents to five cents per 100 lbs., and to have been paid in the shape of transfer and trucking charges.

The Erie road has laid off considerable numbers of car shop men (apparently for a very short time), and the newspapers report that other roads in the anthracite coal region are taking or will take similar action. One account says that repair work is light because the winter has not been severe and another says that the road is reducing expenses in preparation for loss of traffic by reason of the expected strike of coal miners. On April 2 the Chicago & Eastern Illinois laid off 500 shopmen and considerable numbers of trainmen

on account of the expected strike in the coal mines. The Philadelphia & Reading and the Vandalia are said to have confiscated large quantities of coal in transit. The Receiver of the Pere Marquette, anticipating a scarcity of coal, announced last week the suspension of 22 regular passenger trains.

The Lower House of Congress on Monday of this week passed a "personal liability bill" suspending the common law rule which bars a recovery of damages for the personal injury or death of an employee caused by the negligence of a fellow-servant. It makes both parties responsible for their own negligence, and renders void any contract intended to restrict the liability of the employer for the negligence of the employee.

According to Los Angeles papers the damage done by floods last month on the San Pedro, Los Angeles & Salt Lake Railroad will aggregate many hundreds of thousands of dollars, and it was estimated that two weeks' time would be required to put the road in running order. One account said that the roadbed had been destroyed for 100 miles. Within two or three days after the damage was done, 900 men were put at work to restore the track.

Cornelius J. Jackson, the signalman who was on duty at Fifty-third street, New York city, on the Elevated Railroad, last September, when a train was derailed by running too rapidly over a curve, resulting in eight or more fatal injuries to passengers, has been indicted by the Grand Jury and charged with manslaughter in the second degree. Kelly, the motorman, who was the one directly chargeable with causing the derailment, ran away and has never been arrested.

The Supreme Court of the United States has this week held that the Texas law providing a penalty of \$25 a day for failure to furnish cars requested by shippers is unconstitutional, being so arbitrary as to amount to a burden on interstate commerce. The court held that the law made no provision for exemptions through accidents, washouts, fires or congestion of traffic—conditions which would work injustice to the railroads—and as far as it applied to interstate commerce it was unconstitutional.

Baker Street & Waterloo.

The Baker Street & Waterloo was opened for traffic on March 10, from Baker Street to Kennington Road, about three miles. Its two tracks are laid in two iron tubes and the road will eventually be about four and one-half miles long, running from Paddington, on the Great Western, southeast to the Elephant and Castle. The bill permitting the construction of this line was presented to Parliament over 15 years ago, and the scheme has since been in the hands of different companies. The franchise was finally secured by the Underground Electric of London, which has completed the present portion. The existing subways run generally east and west, and the Baker Street & Waterloo aside from providing for a certain amount of north and south traffic is a step towards making the underground system of the city more unified. When completed, the line will connect with the City & South London, the London County Council tramways, the London & South-Western, the Metropolitan District, the Central London and the Great Western.

The greater part of the work was through clay, through which the tunnels were driven by a 12-ft. Greathead shield. A heading about 6 ft. in diameter was first cut by hand and then the shield was driven forward under hydraulic pressure of from 1,200 to 1,600 lbs. per sq. in. The tube was built in behind the shield in 20 in. segments, the space left between the tube and the face of the clay being filled with grouting of lime and water. Progress was at the rate of about 73 ft. a week. The road passes under the Thames between Trafalgar Square and Waterloo Station, and, the bed of the river being composed of gravel, the above method of construction had to be modified. Holes were bored in the heading in front of the cutting edge and filled with clay, so that when the shield was driven forward it left a tunnel lined with packed clay and gravel, in which the segmental tube was built as before.

The electric power is generated at the Lots Road power station of the Underground Electric Company, and there are three sub-stations at Charing Cross, St. George's Circus and Baker street. The current is carried on two high-tension cables and four low-tension cables hung on iron brackets on the tunnel walls. There are 37 electric elevators in all at the different stations. The cars are all steel excepting that fireproof wood is used for some of the internal fittings. The standard train in rush hours consists of six cars, a motor car at each end, with four trailers between; three-car trains are used at other times. The average speed is to be 14 miles an hour, the maximum between stations being 35 miles an hour, and the trains will run on a three minute headway, excepting early in the morning and late at night, when they will be five minutes

apart. They are to be operated only between 5 a.m. and 1 a.m. The Sprague-Thomson-Houston system of multiple control is used, and the signals are automatic and semi-automatic. The motorman is in constant communication with the stations by telephone, and automatic train stops are installed at each signal. The tunnel is lighted at intervals of 40 ft.

Government Advisory Board on Fuels and Structural Materials.

The Government through the Geological Survey and the Forest Service is engaged in investigating the properties and best methods of using the fuels and structural materials of the United States. In order that these investigations may be brought into closer touch with both the producers and users of fuels and structural materials, the President has invited selected members of the national engineering societies and allied organizations to form, with representatives of such Government Bureaus as are carrying on actual construction work, a National Advisory Board on Fuels and Structural Materials.

The Forest Service is now engaged in testing the strength of structural timbers, and expects in the near future to begin tests on the preservative treatment of timbers. In both of these lines it is desired to have all methods and plans of work passed upon by the advisory board.

The organizations which will be represented on the advisory board through the members thus invited by the President are given in the accompanying list.

From the American Institute of Mining Engineers: John Hays Hammond, Robert W. Hunt and B. F. Bush.

From the American Institute of Electrical Engineers: Francis B. Crocker, Henry C. Stott.

From the American Society of Civil Engineers: C. C. Schneider, Geo. S. Webster.

From the American Society of Mechanical Engineers: W. F. M. Goss, Geo. H. Barrus, P. W. Gates.

From the American Society for Testing Materials: Charles B. Dudley, Robert W. Lesley.

From the American Institute of Architects: George B. Post, William S. Eames.

From the American Railway Engineering and Maintenance of Way Association: H. G. Kelley, Julius Kruttschnitt, Hunter McDonald.

From the American Railway Master Mechanics Association: J. F. Deems, A. W. Glbbs.

From the American Foundrymen's Association: Richard Holdenke.

From the Association of American Portland Cement Manufacturers: John B. Lober.

From the Geological Society of America: Samuel Calvin, I. C. White.

From the Iron and Steel Institute: Julian Kennedy, C. S. Robinson.

From the National Association of Cement Users: Rich'd L. Humphrey.

From the National Board of Fire Underwriters: Chas. A. Hexamer.

From the National Brick Manufacturers' Association: John W. Sibley.

Wm. D. Gates.

From the National Fire Protective Association: O. U. Crosby.

From the National Lumber Manufacturers' Association: Nelson W. McLeod, John L. Kaul.

From the Corps of Engineers, U. S. Army: Lieut.-Col. Wm. L. Marshall.

From the Isthmian Canal Commission: Lieut.-Col. O. H. Ernst.

From the Bureau of Yards and Docks, U. S. Navy: Civil Engineer Frank T. Chambers.

From the Supervising Architect's Office, U. S. Treasury Department: James K. Taylor.

From the Reclamation Service, U. S. Interior Department: F. H. Newell.

The Coal and Oil Traffic Investigation.

In the coal and oil investigation ordered by Congress, the Interstate Commerce Commission has directed the Pennsylvania, the Baltimore & Ohio, the Chesapeake & Ohio, the Norfolk & Western, the West Virginia Central & Pittsburgh, the Buffalo, Rochester & Pittsburgh and the New York Central & Hudson River to furnish the following information:

A list of the names and location of all coal mines upon lines or on other roads in which the said companies are interested, giving the rating for each such coal mine for car distribution when car distribution is made upon a basis involving the rating of mines.

A list of the names of stockholders at the last date when stock books were closed, specifying such date, and including the post-office address of each stockholder if that will not occasion delay in complying with this request; and in cases where the last dividend was paid to persons not stockholders of record, the names and post-office addresses of such persons.

A list of the names of stockholders present in person at the last annual meeting, and a list of the names of stockholders voting by proxy, together with the names of persons acting as proxy at such meeting and a blank form of the proxy used.

A map or maps of the lines of railroad owned or operated; also a map or maps of any lines of railroad in which said companies are interested.

A map or maps of the coal territories served by the said companies, or by companies in which said companies are interested, showing the location upon said lines and upon the lines of such other companies of each coal mine from which coal is offered for shipment.

Junk: High Class and Low Class.

The Interstate Commerce Commission, in an opinion by Commissioner Prouty, has rendered its decision in the case of the National Machinery & Wrecking Company against the Pittsburg, Cincinnati, Chicago & St. Louis and others. A box from Georgia for Cleveland was described as one box of scrap iron, weight 3,500 lbs. The Pennsylvania raised the weight from 3,500 to 6,300 lbs., and

insisted that the shipment was not scrap iron but an electric dynamo. The rate upon electric dynamos was \$1.33, while that upon scrap iron was 65 cents. The consignee paid the freight, \$83.79, under protest and filed complaint. The Commission holds that the defendants were justified in applying the dynamo rate, and the complaint will be dismissed; but "the rules of the carriers should be so modified that the shipper could, had he elected, have shipped this dynamo for what it was in fact, viz., junk. We do not attempt to make any order, for we have no authority to do so, but we call this to the attention of the defendants in the hope that they may give it consideration." Whether the rate on a second-hand dynamo shipped from the electric light station to the repair shop should be lower than is charged upon either a new or a second-hand dynamo sent to the station for use is a question of policy for the railroads, and the Commission cannot say that it is unjust or unreasonable to exact the same charge for the new as for the second-hand dynamo. Old dynamos which have become merely combinations of copper, brass and iron scrap and valuable only as junk should, under suitable regulations fixed by the carrier, be given the rating for junk, basing the same on the highest class metal used in the construction.

Not the Usual Program.

An attempt by seven men, wearing masks, to hold up a train on the Southern Railway was foiled on the night of April 2, at Caswell, Tenn., by the vigilance of Engineer Johnson and the bravery of Express Messenger Smith. When Johnson was coming to a halt at Caswell he noticed seven men with faces concealed run from behind the water tank, some toward the engine and others toward the express car. The engineer immediately opened the throttle, and the engine shot ahead before the robbers could reach it. Shots were fired at the engineer, but without effect. Three of the robbers, however, reached the express car, the door of which had been opened by Smith in order to put off some matter for Caswell. When the train shot ahead the messenger was quick to see that something was wrong, and as the robbers sprang to enter the car he knocked them back to the ground. Before they could get to their feet the train was running at a good speed. The robbers in their anger fired into the coaches as they passed, but did no injury.—*New York Times*.

Chicago May Own Its Street Railways.

At the city election in Chicago April 3, municipal ownership of the street railways was the main issue, and the result of the vote is that the city can proceed to acquire and control the railways but cannot operate them. But the voters, while declaring that the city should not operate the railways, declared that, as a question of public policy, it would be desirable for it to do so.

Three propositions were submitted to the voters, the first of which was: "Shall the city of Chicago proceed to operate street railways?" This proposition required 60 per cent. of the total vote cast in order to become effective. The total vote was 231,171; and there were only 120,911 affirmative votes. As a three-fifths vote was necessary, the proposition failed of indorsement by 17,792 votes.

The second proposition involved the approval of an ordinance previously passed by the City Council providing for the issue of street railway certificates, not to exceed \$75,000,000, for the purchase, ownership and maintenance of the street railways. This was carried by about 3,800 votes.

The third proposition was: "Shall the City Council proceed without delay to secure the municipal ownership and operation of the street railways under the Mueller law, instead of granting franchises to private companies?" This proposition was carried by about 3,600 votes. The total vote was much larger than had been expected, and party lines were largely ignored.

The New Sudan Railroad.

The railroad which was opened between Abu Hamed and Karima, 138 miles, early in March, was made entirely with native labor in eight months. This is fast construction, for the district is hilly and difficult for engineering. Interesting pyramid fields are rendered accessible to travelers by this road and the rich province of Dongola is opened to connection with the markets of the east. The line was built under the direction of Macauley Bey and his assistant director, Midwinter Bey.

British Strategy in Afghanistan.

In the course of an interesting lecture on "The Defence of India," Lieut.-Gen. Sir Edwin Colen remarked that the British could not build railroads in Afghanistan in peace time owing to a rooted idea that Great Britain wished to annex the country. Every endeavor ought to be made to broaden the views of the Afghans regarding defensive requirements. The British must continue their policy settled many years ago of linking the vantage points on the frontier with the Indian railroad system.—*London Times*.

An English Consolidation Defeated.

The proposal to transfer the Lancashire, Derbyshire & East Coast Railroad to the Great Central Company has been defeated by the powerful opposition of the Midland, North Eastern, and Lon-

don & North Western. The North Eastern contended that the proposed would give the Great Central control of the output of the Derbyshire coal fields, which would be prejudicial to the interests of the North Eastern. A clause inserted by the Committee in Parliament protecting the North Eastern led the Great Central to withdraw the bill authorizing the consolidation.

The Tattlers' Club.

The so-called "Tattlers' Club" of the Western lines is about to disband because of a lack of business, according to a statement by J. C. Stubbs, traffic director of the Southern Pacific, and chairman of the organization. The "Tattlers' Club" is a committee of executive officials, formed last winter to go to Washington and offer to aid the Interstate Commerce Commission in enforcing the laws against secret rate cutting. "There is no business for the club to perform," declared Mr. Stubbs, who has just returned from a trip through the West. "The railroad men are living up to the law, and I guess we might as well disband."—*Chicago Press Despatch*.

Still Pounding.

Senator Penrose, of Pennsylvania, has introduced in Congress once more that venerable bill "to determine the quantity of the so-called hammer blow of the counterbalance in locomotive driving wheels," etc. The bill provides for an appropriation of \$50,000 to be equally apportioned between the Franklin Institute, Purdue and other institutions.

Enforcing Rates in China.

The Chinese have found a new way of raising railroad rates. We know how to make rates, but it is the Chinese who are showing how to make people pay them. In Canton the Viceroy proclaimed advanced rates on the Hankow Railroad. The merchants' guilds objected and voted not to ship any freight at those rates. Then the Viceroy threatened the merchants with death, and summoned three gunboats from Shanghai. This was reported Jan. 23, and as we hear of no bombardment at Canton, we perhaps may conclude that the merchants have come down with the freight and the money.

The "Commercial Engineer."

The Railway Club of Pittsburgh now confers degrees—or at least we have received from the Secretary a paper which is very like a diploma. It is printed on recherché linen paper, and the letter press is surrounded by an ornate gilt border. It comes about in this way: Mr. George A. Post, in a paper read before the club, last October, declared that "The man who sells things is entitled to a degree"; for he has to hustle, and he has to learn more, know more and suffer more than the workman, the designer, the boss or the proprietor; and therefore Mr. Post suggests that the drummer should have the scholastic title of "Commercial Engineer." With a view to giving wider circulation to Mr. Post's breezy utterances, the club distributes to its members these special illuminated copies of his address.

English Railroads and Motor Omnibuses.

A case of considerable importance to English railroad companies has just been decided by Justice Warrington in the London High Courts. The point raised was whether railroads are entitled to run motor-omnibus services in connection with their lines for conveyance of "pick-up" passengers. The parties to the action were the municipal corporation of Birkenhead and the Mersey Railway Company. The municipality is operating an electric trolley tram-road system within its borough, and the Mersey company owns the electrified tunnel railroad connecting Liverpool with Birkenhead. The tunnel passes under the river Mersey and then the line divides into two branches, one northwest and the other to the southeast and then to the south and on to a southern suburb of Birkenhead. A large part of the railroad's business is in carrying passengers between Liverpool and Birkenhead. It was therefore a public convenience for a line of omnibuses to run between the Central Station and the residential district. The Mersey company established the motor-omnibus service for the convenience of its through passengers, but did not limit the service to this, for it conveyed at low fares many passengers from intermediate points to intermediate points. Here came in the question raised by the Birkenhead municipal corporation: Was the railroad company doing what might fairly be regarded as being incidental to its powers—namely, to build and operate a railroad. Justice Warrington has decided that it was not, and that an injunction should be granted restraining it from running omnibuses "for carrying passengers within the borough of Birkenhead."

Before the case had been heard the Mersey Company had already made application to Parliament for motor omnibus powers and its bill is shortly to come up for consideration. Municipal corporations are generally ready enough to set up competition with railroads by running electric trolley services, but in this case one of them invokes the aid of the law to prevent a railroad company from running motor-omnibus service which was competing with its tramway.

Manufacturing and Business.

S. H. Pitkin has been elected First Vice-President and General Manager of the Wellman-Seaver-Morgan Company, Cleveland, Ohio.

F. H. Rapley, formerly Assistant to the President of the Pressed Steel Car Company, has resigned and has returned to England to accept a position in a manufacturing concern.

The United States District Court of Western Pennsylvania recently dismissed two suits for patent infringement brought by the Stirling Company against the Rust Boiler Company, the court holding that there had been no infringement.

Since the election of Waldo H. Marshall to the Presidency of the American Locomotive Company several changes in the organization of that company have been made. R. J. Gross, formerly Second

Vice-President, is now Vice-President, in charge of the commercial department, including domestic and foreign sales; J. E. Sague, Vice-President, is in charge of manufacturing, and Leigh Best, Vice-President and Secretary, is responsible for the corporate business of the company. A new department has been created to take care of the details of the foreign business, and will be in charge of Charles M. Muchnic, with the title of Manager Foreign Department. Mr. Muchnic, whose portrait we print, is well fitted for the work, having had both practical and commercial experience. He is a graduate of the Drexel Institute of Philadelphia (1896).

In July, 1896, he was employed in the mechanical department of the Baldwin Locomotive Works, leaving there the following year to go to the Brooks Locomotive Works at Dunkirk, N. Y. During the greater part of 1899 he was engaged in locomotive designing work for the Cie. de Flives-Lille, Lille, France. For four months in 1899 and 1900 he worked in the office of A. G. de Glehn, designer of the de Glehn compound, at Mülhausen, Germany, leaving there to go with Sanders & Co., of London, export agents for a number of American industries. In 1901 he returned to this country and served successively as Chief Draftsman and Mechanical Engineer of the Wisconsin Central and Mechanical Engineer of the Denver & Rio Grande, resigning the last-named place in January, 1903, to become assistant to Mr. Gross. He accompanied Mr. Gross in that capacity on the latter's trip around the world in 1903. Mr. Muchnic has made several trips to Europe in the interests of American locomotive builders, and has naturally acquired an acquaintance among railroad officials in all parts of the world. He has a good command of several foreign languages.

Iron and Steel.

The Western Maryland has given contracts for 6,000 tons of girders.

According to newspaper reports the Tennessee Coal & Iron Co., of Birmingham, Ala., is planning to build additions to its works at Birmingham and to put up a steel mill at Thomas. The syndicate of which John W. Gates is President, which recently bought a controlling interest in this company, is planning to make improvements.

Orders have recently been given for rails as follows: The Northern Pacific 30,000 tons, and the Great Northern 20,000 tons from the Lackawanna Steel Co.; the Atchison, Topeka & Santa Fe 40,000 tons from the Pennsylvania Steel Co., and 10,000 tons from the Cambria Steel Co. The latter has also received an order from the Central of Georgia for 10,000 tons, and for a similar amount from the Chesapeake & Ohio. The Buffalo, Rochester & Pittsburg has given an order for 2,000 tons, the Erie for 4,000 tons, and the Fredericksburg & Potomac, 4,300 tons. The Grand Trunk Pacific has given a contract to the United States Steel Corporation for 50,000 tons of rails. Additional contracts have recently been given to the American Bridge Co. by western parties for 8,000 tons of steel. The output of rails for 1906, estimated by present orders, will exceed that of last year by 50 per cent. The Carnegie Steel Co., which has a capacity of about 4,000 tons a day at its Edgar-Thomson works, at Bessemer, Pa., and its Ohio works at Youngstown, Ohio, has orders for 1,200,000 tons of rails. The Illinois Steel Co., with works at Chicago, has orders for 900,000 tons. The large rail mill at Birmingham, Ala., of the Tennessee Coal & Iron Co., which makes only



C. M. Muchnic.

open hearth rails, has contracted for its entire output up to March of next year. These is every indication that the orders this year will reach a total of 3,200,000.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

American Society of Civil Engineers.

At the business meeting of this society April 4, a paper on the Panama Canal by A. G. Menocal, was presented for discussion. This paper was printed in the *Proceedings* for February, 1906.

Railway Telegraph Superintendents.

The Association of Railway Telegraph Superintendents will hold its annual meeting at Denver, Colo., beginning June 20. Headquarters will be at the Adams Hotel. The President of the Association is Mr. E. E. Torrey, of the Mobile & Ohio.

American Society of Mechanical Engineers.

At the fifty-third meeting of this society, to be held at the Read House in Chattanooga, Tenn., May 1-4, the following papers will be presented: "Low Resistance Thermo-Electric Pyrometer and Compensator," by William H. Bristol; "Manganese Steel," by Henry D. Hibbard; "History of the Introduction of a System of Shop Management," by James M. Dodge; "Collapsing Pressures of Bessemer Steel Lap-Welded Tubes," by R. T. Stewart; and "New Liquid Measuring Apparatus," by George B. Willcox.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Seaboard Air Line.—Alfred Walter, Chairman of the Board of the South & Western, has been elected President of the S. A. L., succeeding J. M. Barr, resigned as President.

Southern Pacific.—James Speyer and Charles H. Tweed, of Speyer & Co., have resigned from the Board of Directors.

Operating Officers.

Central New England.—O. M. Laing, Assistant Superintendent, has been appointed Superintendent, with office at Hartford, Conn., succeeding J. F. Hedden, resigned. J. H. Turbush succeeds Mr. Laing.

Chicago, Burlington & Quincy.—A. N. Willsie, Master Mechanic at Brookfield, Mo., has been appointed Superintendent at St. Joseph, Mo., succeeding A. T. Perkins, resigned.

Evansville & Terre Haute.—J. O. Crocket, Superintendent, has been appointed General Manager, succeeding F. P. Jeffries, resigned.

Great Northern.—R. W. Bryan, Superintendent at Melrose, Minn., has been appointed to the new office of Master of Transportation. Frank Bell, Superintendent of Car Service, succeeds Mr. Bryan.

Missouri, Kansas & Texas of Texas.—Charles Hammond, Trainmaster at Trinity, Tex., has been appointed Superintendent at that place.

Traffic Officers.

Charleston & Western Carolina.—R. A. Brand, Freight Traffic Manager, has been appointed Traffic Manager, succeeding H. M. Emerson, deceased.

Lehigh Valley.—C. A. Blood, General Freight Agent, has been appointed Freight Traffic Manager, succeeding T. N. Jarvis, promoted. H. C. Burnett, Assistant General Freight Agent, succeeds Mr. Blood.

Missouri, Kansas & Texas.—W. M. Fenwick has been appointed Assistant General Passenger Agent at St. Louis, Mo.

Engineering and Rolling Stock Officers.

Atlantic Coast Line.—C. L. Meister has been appointed to the new office of Mechanical Engineer, reporting to the General Superintendent of Motor Power.

Chicago, Milwaukee & St. Paul.—Edward Laas, Superintendent at Ottumwa, Iowa, has been appointed to the new office of Engineer of Maintenance.

Grand Trunk.—G. J. Bishop, Master of Bridges and Buildings, at Durand, Mich., has resigned. The authority of T. T. Irving, Resident Engineer at Detroit, has been extended over the Bridges and Buildings Department heretofore in charge of Mr. Bishop.

New York Central & Hudson River.—G. W. Kittredge, Chief Engineer of the Cleveland, Cincinnati, Chicago & St. Louis, has been appointed Chief Engineer of the N. Y. C. & H. R., effective April 9.

Northern Central.—See Pennsylvania.

Pennsylvania.—H. M. Carson, Superintendent of Motive Power at Buffalo, has been appointed Assistant to the General Manager. R. J. Reading, Superintendent of Motive Power at Williamsport, Pa., succeeds Mr. Carson. D. M. Perine, Master Mechanic at West Philadelphia, succeeds Mr. Reading. J. T. Wallis, Master Mechanic of the Northern Central at Baltimore, Md., succeeds Mr. Perine. J. C. Mengel, Master Mechanic at Sunbury, Pa., succeeds Mr. Wallis. J. M. Henry, Master Mechanic of the Northern Central at Elmira, Pa., succeeds Mr. Mengel. C. K. Shelby, Assistant Engineer of Motive Power at Williamsport, succeeds Mr. Henry. J. L. Cunningham, General Foreman at Columbia, Pa., succeeds Mr. Shelby.

Union Pacific.—J. C. Young, heretofore General Signal Inspector on the Southern Pacific, has been appointed Signal Engineer of the U. P., with office at Omaha, Neb.

LOCOMOTIVE BUILDING.

The Pennsylvania has ordered 100 locomotives from the Baldwin Works.

The Mexican International, it is reported, is in the market for locomotives.

The Southern, it is reported, will shortly order additional locomotive equipment.

The Maryland & Pennsylvania, it is reported, has ordered one 10-wheel locomotive.

The Queen & Crescent has ordered three locomotives from the Baldwin Locomotive Works.

The Chesapeake & Ohio has ordered three 150-ton Shay locomotives from the Lima Locomotive & Machine Co.

The Minnesota Land & Construction Co., Duluth, Minn., has ordered six consolidation locomotives from the American Locomotive Co.

The Lima Locomotive & Machine Co. report the following orders for the week ending March 31: Davidson Lumber Co., Bridgewater, N. S., one 17-in. x 24-in. six-wheel switching locomotive; Marysville & Northern, Bryant, Wash., one 37-ton Shay locomotive; Clear Creek Lumber Co., Birmingham, Ala., one 37-ton Shay locomotive; Flat Creek Mill Co., Mobile, Ala., one 37-ton Shay locomotive, and the Culbreath Logging Co., Huttig, Ark., one 37-ton Shay locomotive.

The Chicago & Western Indiana has ordered five simple mogul (2-6-0) and five six-wheel switching (0-6-0) locomotives from the American Locomotive Co., for August delivery. The mogul locomotives will weigh 160,000 lbs., with 140,000 lbs. on the drivers; cylinders, 20 in. x 28 in.; diameter of drivers, 57 in.; extended wagon top boiler, with a working steam pressure of 200 lbs.; 330 tubes, 2 in. in diameter and 13 ft. long; Otis steel firebox, 102 in. x 66 in.; grate area, 47.4 sq. ft.; tank capacity, 6,000 gallons, and coal capacity, eight tons. The switching locomotives will weigh 142,000 lbs.; cylinders, 20 in. x 26 in.; diameter of drivers, 51 in.; straight boiler, with a working steam pressure of 200 lbs.; 331 National tubes, 2 in. in diameter and 11 ft. long; Otis steel firebox, 108 in. x 42 in.; grate area, 31.4 sq. ft.; tank capacity, 6,000 gallons, and coal capacity, eight tons. The special equipment for both includes: Westinghouse air-brakes, Otis axles, Cooke & Strong bell ringer, National-Hollow brake-beams, Perfecto brake-shoes, Gould couplers, Schroeder headlights, Nathan injector and sight-feed lubricators, Cicero bronze journal bearings, Jerome piston rod packings, American Balance Valve Co.'s valve rod packings, Ashton safety valve and steam gages, Leach sanding devices, French springs, Gold steam heat equipment and Midvale driving, truck and tender wheel tires.

CAR BUILDING.

The Western Maryland is in the market for one private car.

The Florida & East Coast is in the market for 100 box cars.

The Pennsylvania, it is reported, is contemplating the purchase of a number of additional freight cars.

The Merchants Despatch Transportation Co. will build a number of refrigerator cars at its Despatch shops.

The New Orleans & Northeastern contemplates getting additional equipment, but nothing has yet been arranged.

The Rogers & Southwestern wish to buy a combination passenger, baggage and mail coach and a second-hand passenger coach.

The Minnesota Land & Construction Co., Duluth, Minn., has ordered 100 flat cars of 80,000 lbs. capacity from Fitz-Hugh, Luther Co.

The Atchison, Topeka & Santa Fe has ordered 12 cabooses from

the American Car & Foundry Co., and is asking bids on 100 tank cars.

The Huntingdon & Broadtop has ordered 300 all steel hopper coal cars of 100,000 lbs. capacity from the American Car & Foundry Co.

The Maryland & Pennsylvania, it is reported, has ordered 25 standard box cars of 60,000 lbs. capacity, eight standard gondola cars of 60,000 lbs. capacity, two stock cars and three passenger cars.

BRIDGE BUILDING.

BROWNSVILLE, PA.—The Lower House of Congress has passed a bill authorizing the Fayette Bridge Co. to build a highway bridge across the Monongahela river near this place.

CLARKSVILLE, TENN.—The Lower House of Congress has passed the bill authorizing a bridge across the Cumberland river at or near this place. (Feb. 23, p. 60.)

CLEVELAND, OHIO.—Announcement has been made by City Engineer Carter that between \$300,000 and \$350,000 of the \$500,000 issue of grade crossing bonds, which will soon be issued, will be used to build a bridge through the upper flats connecting Clark with East Clark avenue, the south side and Newburg.

FORT FRANCIS, ONT.—W. H. Cook, Duluth, Minn., will receive bids for building a bridge over the Rainy river, between this place and Koochiching, Minn., for the Duluth, Rainy Lake & Winnipeg.

GAINESVILLE, GA.—Several steel bridges will soon be built in Hall County.

INDIANOLA, IOWA.—The Board of County Supervisors at their meeting April 9 will receive bids for two steel bridges to be built in Warren County.

MINNESOTA.—The bill authorizing a bridge across Rainy river in this state was passed by both Houses of Congress.

MISSISSIPPI.—The Lower House of Congress on March 26 passed the bill authorizing the counties of Holmes and Washington to build a bridge across the Coldwater river. (Jan. 26, p. 28.)

MONTANA.—Both houses of Congress have passed the bill authorizing the Chicago, Milwaukee & St. Paul Railway Co. to build a bridge across the Yellowstone river in this state. (March 20, p. 97.)

NASHVILLE, TENN.—The Lower House of Congress on March 26 passed a bill authorizing two bridges across the Cumberland river at or near this place. (Feb. 23, p. 60.)

NIAGARA FALLS, N. Y.—The International Railway Co. and the Toronto Railway Co. are planning to jointly build a new bridge to carry electric cars over the Niagara river 300 ft. below the present steel bridge at Niagara Falls. A bill will be introduced in the New York State Legislature to incorporate the Trans-Niagara Bridge Co., with a capital of \$1,000,000, to carry out this work. F. Nicholls, D. E. Thompson, of Toronto; G. B. Schley, of New York; H. J. Pierce, of Buffalo; F. A. Dudley, of Niagara Falls, and others are named as commissioners in the bill. The commissioners will appoint a committee to locate the site for the bridge, and will have an office at Niagara Falls.

PINKERTON, ONT.—Bids are wanted April 9 by J. J. Donnelly, Clerk of Greenock township, for building a 90-ft. span Warren truss steel bridge, with 14-ft. roadway, over the Teeswater river. Also for a 110 ft. steel span over the same river.

SOUTH DAKOTA.—Both Houses of Congress have passed the bill authorizing a bridge across the Missouri river between the counties of Walworth and Dewey in this state. (March 30, p. 97.)

TORONTO, ONT.—City Engineer Rust is making plans for building a bridge at Bathurst street to carry street cars.

WARSAW, IND.—Bids are wanted April 16 by Eff Sharp, County Auditor, for building five steel bridges in Kosciusko County.

WASHINGTON.—Both Houses of Congress have passed the bill authorizing a bridge across the Snake river between the counties of Whitman and Columbia in the state of Washington. (March 30, p. 98.)

Other Structures.

BIRMINGHAM, ALA.—Stollitt & Co., of Chicago, will have the contract for building a union passenger station here, to cost \$1,500,000. It is expected to have the structure completed by January, 1907.

CHICAGO, ILL.—Negotiations for the purchase of land between Madison and Randolph streets and Clinton and Canal streets, it is said, have been made for the Chicago North-Western, which is said to be planning to build a large passenger station on this site.

The Pennsylvania, it is reported, has secured land on which it will put up a large passenger station.

DECATUR, ILL.—The Wabash has given a contract to James Stewart & Co., of St. Louis, for the following work: Car shop, 88 ft. x 484 ft.; blacksmith and machine shop, 80 ft. x 294 ft.; wood working mill, 80 ft. x 238 ft.; storeroom, 40 ft. x 464 ft., with a two-story office building at one end; cabinet, tin, upholstery, glazing and electrical work shop, 40 ft. x 550 ft.; coal, iron and coke shed, 20 ft. x 294 ft.; power house, 60 ft. x 108 ft.; dry kiln, 20 ft. x 80 ft., with reinforced concrete roof and floors and some small sheds. Bids are being asked by C. A. Howe, Acting Purchasing Agent, for the machinery for these shops.

HOMESTEAD, PA.—The Pennsylvania, it is said, has plans ready for putting up a brick passenger station here, to cost \$20,000.

KNOXVILLE, TENN.—The Southern, it is said, has selected a site for a new shop building.

MILWAUKEE, WIS.—The Chicago, Milwaukee & St. Paul will increase its shops at this place and make this the shop headquarters for its entire system. The improvements include an addition to the car erecting shop, which will be 80 ft. x 668 ft., with a second addition to the same building 44 ft. x 103 ft., giving a total area of 58,000 sq. ft. in addition to the present area of 60,000 sq. ft. A concrete blacksmith shop will be built 80 ft. x 600 ft., which will be equipped with machinery to build cars and locomotives. The cost of these improvements will be about \$500,000.

OMAHA, NEB.—The Chicago & North-Western has bought four parcels of land from Thirteenth to Fourteenth streets and from Webster to Davenport streets as a site for a new passenger station.

PHILADELPHIA, PA.—The Philadelphia & Reading is asking bids for building an additional story on its Calowhill street freight office.

PORTSMOUTH, OHIO.—The Norfolk & Western, according to a statement, is planning to build, during the present year, a 20-story brick roundhouse, with an 85-ft. span; a car shop, 65 ft. by 300 ft., and smith shop, 72 ft. by 144 ft.

ROANOKE, VA.—The Norfolk & Western plans the building of a foundry 144 ft. x 740 ft.; paint storehouse, 63 ft. x 82 ft., and a boiler shop, 39 ft. x 51 ft. The present paint shop, 74 ft. x 152 ft., is to be extended to 74 ft. x 300 ft. All the buildings will be of brick and steel.

ROCHESTER, N. Y.—An appropriation of \$250,000, it is reported, has been made by the New York Central to rebuild and enlarge its passenger station in this city.

SCRANTON, PA.—The Delaware, Lackawanna & Western will commence work at once on new yards and put up a number of buildings at a total cost of about \$2,000,000.

VERA CRUZ, MEX.—The Mexican Federal Government has approved the plans of the Vera Cruz Terminal Association, formed by the railroads entering that port, for a new union passenger station and terminals, to cost about \$6,000,000. Contracts for the work will soon be let.

YORK, PA.—The Maryland & Pennsylvania is to build a new freight house and make other improvements.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALASKA CENTRAL.—The annual report for 1905 says that the road, which was originally a light line with heavy grades, is to be made a first-class road. It has been decided to reduce the maximum grade to one per cent., excepting only two per cent. across the mountain ranges. This will necessitate the building of seven tunnels on the first 55 miles of road. Along the north shore of Turnagain Arm, where the road will be built on the side of the mountain for a distance of 30 miles, the work is very heavy and expensive. The cost of the rock excavation will be between \$40,000 and \$80,000 a mile. The work of locating the line has been slow and costly, the sum of \$140,000 having been spent last year on this work. A force of engineers, in charge of G. A. Kile, Chief Engineer of Surveys, completed last year the permanent location of 87 miles, preliminary location of 260 miles, and reconnaissance surveys for 780 miles. At Seward, the southern terminus of the road, the company has rebuilt its wharves, and the terminals were enlarged and improved. An office building costing approximately \$50,000 has been put up. A temporary roundhouse and a machine shop have been built, and plans made for a permanent roundhouse and shops, on which construction work will soon be started. The first 14 miles of road have been reconstructed to reduce the grade and straighten the line. The cuts and fills were widened, and the road is now completed and in operation to mile 45. Considerable work has been done between

that point and mile 105; contracts for six of the tunnels at mile 52 let to Rich & Harris last summer, call for the completion of this work early this month. The grade from mile 75 to mile 105 along the north shore of Turnagain Arm, which includes the heaviest rock work on the entire road, with the exception of the tunnels, has been let to P. Welch & Co., of Spokane, whose contract calls for the completion of this work by August. Both of these contractors are actively pushing the work, although experiencing great difficulty in securing and retaining labor to carry out the work. The company has lost about 1,000 men during the year, most of whom have left railroad work to become prospectors. During the winter there has been employed an average of 1,200 men, and this force is to be increased during the summer. The track is laid with 65-pound rails and ties 2 ft. apart on centers. The bridges and trestles will be built of heavy timber capable of carrying loaded 80,000-lb. capacity cars. Nearly \$2,000,000 has already been spent on construction. One of the tunnels at mile 49 will be 800 ft. long, and it is expected to have this and the other tunnels completed early in July. The company is planning to let contracts for building the road from mile 105 to mile 150, and it hopes to have this part of its road completed during the present year. It also is to build the Matanuska branch from a junction with the main line, at mile 150, 30 miles east to the Chickaloon coal fields. Contract has been given to the Illinois Steel Co. for delivery during the present summer of 5,000 tons of rails and fittings. (March 30, p. 98.)

BATON ROUGE, HAMMOND & EASTERN.—This company has been organized in Louisiana to build a railroad from Baton Rouge, east via Hammond and Covington to Nicholson, thence northeast to Merrill, Miss., where connection is to be made with the Mobile, Jackson & Kansas City. The road will traverse a fine timber and agriculture district. S. O. L. Wexler is President of the company. It is expected to have the road completed as far as Hammond this year. The office of the company will be in Baton Rouge.

BROOKLYN RAPID TRANSIT.—On the Sea Beach line of this company additional switching and terminal tracks are being put in. At Sheepshead Bay the tracks of the Long Island Railroad will be used to run to the race course. The Canarsie line, formerly operated by steam power by the Brooklyn & Rockaway Beach Company, is to be practically rebuilt and equipped with electric power, and extended. The tracks will be relaid with 70-lb. rails and new terminals built. The company expects to run trains from the Manhattan end of the Williamsburg bridge to Canarsie in 30 minutes. The power station at Williamsburg is nearing completion. This will furnish an additional 12,000 h.p., and more trains can be run. Work will also be started on the improvement of the tracks on other lines of the company.

CAIRO, MAYFIELD & NASHVILLE.—See Nashville, Chattanooga & St. Louis.

CANADIAN PACIFIC.—The President of this road, Sir Thomas Shaughnessy, announces that the company, during the present year, will complete 867 miles of new line. The most important of these are the following: Sudbury-Toronto line, through a rocky section with a maximum grade of three-tenths of 1 per cent.; Gulf & Goderich with a number of branch lines which will furnish a new service between Toronto and Goderich. New lines in the west include the Wolseley branch to Reston, 122 miles, which it is expected will furnish an outlet for wheat shipments next fall to Regina; the Pheasant Hills extension and the Edmonton & Wataskawin. These will furnish the company another through trunk line from Winnipeg to Edmonton. The Manitoba & Northwestern branch will pass through Grand Trunk territory and give access to the Quill and the Touchwood mountain section. The Gimli extension in Manitoba will furnish an outlet for the fishing industries on Lake Winnipeg, and the Teulon extension a through line to the fertile section west of Lake Winnipeg. The extension from Lander to Broomhill will furnish an additional through line to Southwestern Manitoba, and in British Columbia the Nicola-Kamloops line will run through the fruit valleys of the Nicola Lake region.

CINCINNATI ROADS.—A company has been formed and a bill introduced in the State Senate authorizing the building of an overhead road from one of the suburbs of this city to the down town district.

COLLEGE CITY & SOUTHERN.—Incorporation has been granted a company under this name in Oklahoma, with a capital of \$500,000, to build a railroad from Kiowa, Kan., to Alva, 35 miles. The office of the company will be at Alva. E. T. McNight is President and General Manager; T. G. Woodward is First Vice-President; J. B. Kent, Second Vice-President; W. B. Taylor, Secretary, and J. B. Dullin, Treasurer.

COBALT RANGE.—Application will be made to the Dominion Parliament for the incorporation of this company to build a railroad from Haileybury, Ont., east through the Cobalt district via Fort Temiskaming and Villa Marie, thence southeast to a connection with other roads. Lake Temiskaming is to be crossed by a car ferry.

CO-OPERATIVE CONSTRUCTION.—This company has been incorporated with a capital stock of \$10,000 to build an electric line from Grand Rapids, Mich., northwest via Fremont, Hesperia, Hart and Pentwater to Ludington, about 95 miles. The officers are: George E. Hilton, President; John Pikart, Vice-President; John G. Anderson, Secretary, and Thos. David, Treasurer, all of Fremont.

DETROIT & ADRIAN TRACTION CO.—Incorporation has been asked for by a company under this name, in Michigan, to build an electric road from Detroit to Adrian, about 60 miles. Such a line would parallel the Wabash from Detroit to Milan.

EAST CENTRAL.—Incorporation has been granted this company in Florida, with a capital of \$1,000,000, to build a railroad from Ormond south to Daytona, thence west to De Land, and thence south to Sanford and Orlando, about 70 miles. E. L. Potter, Seabreeze, is President; J. Clyde Power, Indianapolis, is Vice-President; S. H. Grove, Daytona, General Manager; J. Hall Brumsey, De Land, Secretary, and J. B. Crocker, Seabreeze, Treasurer. The first regular meeting of the company is to be held on April 5 at De Land.

ELGIN & DUPAGE (ELECTRIC).—A charter has been granted a company under this name, in Illinois, with a capital of \$10,000, to build an electric line from River Forest, in Cook County, west through Cook and Du Page counties to Elgin, in Kane County, about 40 miles.

ELK SHORT LINE.—This company has been incorporated in Michigan with a capital stock of \$8,000 to build a short railroad in and near the village of Elk Rapids. The directors are Homer Sly, Milton B. Lang, Harry Hirshberg, Helmuth Krarup and Fitch R. Williams, all of Elk Rapids.

ERIE.—The directors of this company have authorized surveys to be made for the electrification of the Rochester division from Rochester to Corning, N. Y.; also of the Bath & Hammondsport and the Mt. Morris branch from Avon to Mt. Morris. The total mileage to be electrified is approximately 150 miles.

GRAND TRUNK PACIFIC.—Contract has been given to Cash Bros. for building the first section of this road in Alberta. Work will be started at a point 110 miles east of Lacombe, near the Battle river.

GREAT NORTHERN.—Surveys, it is said, are being made by this company to build an extension from its existing line near Wenatchee on the Columbia river in Washington, north on the west bank of that river through Chelan County, giving an outlet to the Colville Wheat Belt and Okanogan Mines.

Vice-President Louis W. Hill has confirmed the report that this company will build a line through Canada to the Pacific coast. According to Mr. Hill: "The only interest we have in the Canadian Northern is that we lease its lines from the boundary up to Winnipeg. But we have already secured our own terminals in Winnipeg and we shall soon build a Winnipeg line of our own. Then we shall be entirely independent of the Canadian Northern. Our line includes only 800 or 900 miles that are still to be constructed west of Winnipeg. The Grand Trunk Pacific has done nothing yet in that section. It has been stated that the Grand Trunk must take four or five years to finish their line but we could complete ours within two or at any rate within three years."

GULF, PLAINVILLE & NORTHERN.—A charter has been granted to a company under this name in Kansas with a capital of \$1,000,000. The incorporators are all residents of Plainville, Kan. The company proposes to build 60 miles of railroad from Plainville north to the Nebraska line. It is reported in Topeka that the project is being backed by Union Pacific interests.

INDIANA ROADS.—Announcement has been made that William Kenefick, of Kansas City, and associates will organize a company with a capital of \$25,000,000, to build a railroad with a northern terminus at Tolleston, in Lake County, Ind., to run south via Indianapolis to Evansville, with a number of branches. It is proposed to enter Chicago over the Chicago Belt Road.

LAKE ERIE & SOUTHERN.—Incorporation has been granted this company in Ohio, with a capital of \$125,000, to build a railroad from Cleveland south via Akron to Massillon, about 60 miles, and to ultimately extend the road further south. The incorporators are R. T. Wood, H. B. Camp, J. R. Zmunt, F. W. Green and H. McIntyre, all of Cleveland.

LAKE SHORE & MICHIGAN SOUTHERN.—This company will do considerable four-tracking work between Toledo and Cleveland during the present year. The section from Toledo to Holland on the west, and from Toledo to Milbury on the east, 15 miles, has been completed. A considerable amount of four-tracking will also be carried out during the present year between Toledo and Chicago. Work is being pushed on the road east of Cleveland.

LORAIN & WEST VIRGINIA.—See Wabash.

LOUISVILLE & NASHVILLE.—Contract has been given by this com-

pany to Kreis Bros., of Knoxville, Tenn., for building a four-mile branch from a point on its line two miles south of Mentor to Maryville, in Blount County. The contract calls for completion of the grading by the end of July next.

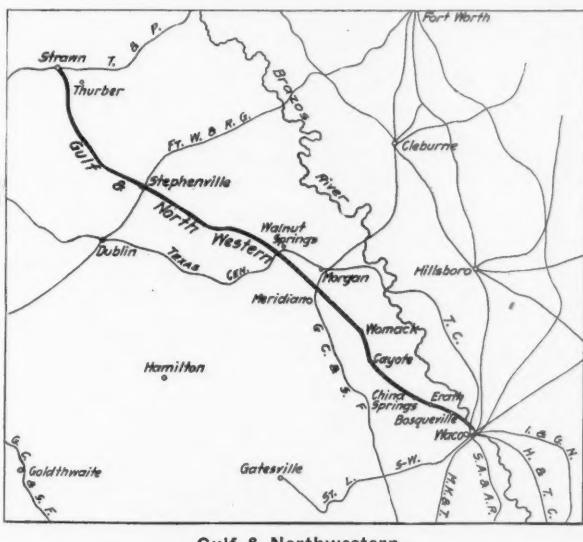
MARTINEZ & CONTRA COSTA.—Incorporation has been granted this company in California, with a capital of \$100,000, to build a steam or electric railroad, five miles long, in the city of Martinez, Cal., under the franchise granted to M. R. Jones.

MIDLAND RAILWAY.—Contract has been given by this company to the Guthrie Co., of St. Paul, Minn., for grading its road from Portage la Prairie, Kan., to the international boundary, between 80 and 90 miles.

MISSOURI, KANSAS & TEXAS.—According to newspaper reports this company is planning to build a line from Palestine, Tex., via Athens, to Dallas, and is now making surveys.

This company expects to run trains into Austin this month over the tracks of the International & Great Northern.

GULF & NORTHWESTERN.—An officer writes that bids are wanted for building this road, to include the bridges, water stations, etc. Surveys have just been completed from Waco, Tex., at the head of navigation on the Brazos river, northwest via Bosqueville, Erath, China Springs, Cayote, Womack and Adle's ranch, crossing the Gulf, Colorado & Santa Fe between Meridian and Morgan. The Texas Central will be crossed near Walnut Springs, and thence the line runs up the East Bosque valley via McCurdy and Daniel's ranch, Matheron Gap, Johnsville and Bunker Hill to Stephenville, where the Fort Worth & Rio Grande is crossed; thence up the South



Gulf & Northwestern.

Bosque valley, through Cage's ranch, Berlin and Twin Mountains; through the Thurber coal fields to Strawn on the Texas & Pacific, a total distance of 122.1 miles. The first 75 miles will have a maximum grade of 0.8 per cent. and the balance 1.0 per cent. McCarthy, Starnes & Co., Consulting Engineers, of Lufkin, Tex., are the engineers in charge. (See Construction Record.)

NASHVILLE & VALDOSTA.—A charter has been granted this company in Georgia, with a capital of \$300,000, to build a railroad from Valdosta north to Nashville, in Berrien County, about 35 miles. The incorporators are residents of Nashville and Valdosta.

NASHVILLE, CHATTANOOGA & ST. LOUIS.—Under the name of the Cairo, Mayfield & Nashville this company is planning to build a line to Cairo, Ill., from Murray, Ky. Such a line will be a competitor of the Illinois Central. The leasing of the Tennessee Central by the Illinois Central is said to be the incentive to the building of this line.

NEW YORK, NEW HAVEN & HARTFORD.—Work will soon be started on the rebuilding of the Highland division of this road from Waterbury, Conn., northeast to Bristol, 14 miles. This involves some very heavy work, including the relocation of much of the line and a tunnel 35,000 ft. long. The present ruling grade of 75 ft. to the mile is to be reduced to 57 ft.

NORTHWESTERN DEVELOPMENT COMPANY.—Under this name the Northwestern Commercial Company, which controls several enterprises in Alaska, it is said, in connection with J. P. Morgan & Co., A. A. Housman & Co., and the Guggenheim interests, is organizing the above company, with a capital of \$6,250,000, to build a railroad from Nome, Alaska, northeast for a distance of 120 miles. H.

C. Davis is President; K. K. McLaren, Vice-President, and John Rosene, Chairman of the Board.

PENNSYLVANIA.—This company has given a contract to H. S. Kerbaugh for the grading, masonry and track laying of its proposed eastbound receiving and classification yards at Pitcairn. The work calls for the laying of about 30 miles of track. The company has practically decided to change the grade and alignment of its tracks through New Florence, Pa. The work includes the building of a subway at Ligonier, the elevation of the tracks 8 ft., and the lowering of the street grade 8 ft.

A contract has been given by this company at about \$1,000,000 to Reilly & Weber for laying tracks in its eastbound classification yard at Hollidaysburg.

This company is asking bids April 16 for piercing a tunnel at Blairsville, Pa.

PENNSYLVANIA SYSTEM.—The record of mileage for the year ended December 31, 1905, shows that the total length of main line on the lines East of Pittsburg and Erie is 5,186 miles, with 1,647 miles of second track, 550 miles of third track, 438 miles of fourth track, and 3,888 miles of company's sidings, a total of 11,708 miles. There was a decrease during 1905 of four miles of first track, and an increase of 66 miles of second, third and fourth tracks, and 248 miles of sidings, a total increase of 310 miles. On the Pennsylvania lines West of Pittsburg and Erie the mileage is 2,867 miles of first track, 1,089 miles of second track, 130 miles of third track, 77 miles of fourth track, and 2,118 miles of company's sidings, a total mileage of 6,281. During the year there was an increase of six miles of first track, 78 miles of second, third and fourth tracks and 144 miles of sidings, a total increase of 228 miles. The mileage of the Vandalia Railroad is: First track, 928 miles; second track, 65 miles; sidings, 595 miles; a total of 1,587 miles. During the year there has been an increase in first track of 131 miles, second track 46 miles, and sidings 193 miles, total, 370 miles. The grand total of all lines, including those operated by and associated in interest with the Pennsylvania Railroad, is 10,907 miles of first track, 2,977 miles of second track, 696 miles of third track, 522 miles of fourth track, and 7,263 miles of sidings, a total of 22,365 miles. Of this, 6,030 miles of first track are East and 4,877 miles of first track are West of Pittsburg and Erie.

PHILADELPHIA RAPID TRANSIT.—Mayor Weaver on March 28 signed the ordinance granting this company an extension of three years for the completion of its Market street subway. In consideration of this extension, the company has filed, with the Secretary of the Commonwealth at Harrisburg, and with the City Solicitor of Philadelphia, a full surrender of all other franchises acquired by the company several years ago with two exceptions. The company also agrees to pay \$400,000 towards the cost of abolishing certain grade crossings. (March 30, p. 99.)

PHILIPPINE RAILWAY.—This company, which was lately incorporated in Connecticut, with a capital of \$5,000,000, is to build 300 miles of railroad. William Salomon & Co., of New York, are the bankers for the syndicate that is to finance the construction. The Philippine Railway Construction Company, incorporated in New Jersey, with a capital of \$1,000,000, has given the contract to J. G. White & Co., of New York, to build the road. (See Construction Record.)

PITTSBURG, CINCINNATI, CHICAGO & ST. LOUIS.—The work under way by this company, according to its yearly report, includes the following: Change of alignment and construction of eastbound freight track from Bulger to R. S. tower. This includes a cut at tunnel number three. Change of grade and construction of second track from Woodstock to Hagenbaugh 10.3 miles, including new east and westbound passing sidings at Brush Lake and at Hagenbaugh; construction of second track from Hagenbaugh to Urbana, 6.5 miles, and reduction of grade in Urbana. Second track from Summit to Bradford, 7.56 miles, change of grades and alignment through Covington and the abandonment of grade crossings of the Cincinnati, Hamilton & Dayton, and street crossings in Covington, also the construction of a new double-track bridge over Stillwater river. Second track from Bradford to Horatio, 5.68 miles, together with a change of grade, has been completed. The freight track from Aylesworth to P. V. tower, 11.39 miles, has been converted into a second main track. Work is under way on the classification yard at Columbus, Ohio, to increase its capacity 150 cars. A produce yard, with a capacity of 51 cars, was built in yard C at Columbus, Ohio, and extensive changes made in the yard at Bradford, Ohio, in connection with the building of a second track, which included part of the yard track and the laying of 5.7 miles of new track. Two miles of additional storage tracks were laid between 63d and 72d streets, Chicago, and five additional tracks were laid at Campbell avenue. New freight stations were put up at Ingram and Burgettstown, and combined passenger and freight stations at Mill Grove and McGrawsville. A commissary house was built at Dennison avenue, Columbus, for the use of the dining car department.

ment, together with the necessary tracks; and new house for trainmen is under construction at 59th street, Chicago. At Dennison, Ohio, a 32-stall roundhouse, with a 75-ft. turntable, oil house, coal hoist and a complete water system, is being put in. A water softening plant and coaling station has been completed at Bradford, and a new coaling station put up at Logansport, also a water softening plant put in at Richmond. The work of elevating the tracks in Chicago from Fulton street to Ashland avenue, with a run-off to a point 300 ft. east of Ada street is practically completed. This involves the elevation of the run-off of the Rock street elevation between Fulton street and Weston avenue 1,500 ft., thence west over 10 streets for about one mile, thence to a grade crossing at Ada street 1,900 ft. The track was raised for a distance of 1.64 miles. All the work in connection with the elevating of the tracks from the Illinois and Michigan canal to Weston Avenue Boulevard has been completed with the exception of the crossing at the Chicago & Alton road at Weston avenue, where the tracks are not elevated to the new grade, pending action of the Chicago & Alton, as to the abandonment of the grade crossing.

SANDUSKY, FREMONT & SOUTHERN.—Incorporation has been granted this company in Ohio, with a capital of \$10,000, to build a railroad from Sandusky, on Lake Erie, southwest to Fremont, in Sandusky County, about 30 miles. The incorporators include G. H. Kelly, M. G. McAlleman, T. H. Hogsett, H. H. Johnson and George C. Ford.

SOUTHERN.—Contracts are reported let by this company at about \$5,000,000 for laying second track between Knoxville and Morris-town, and Chattanooga and Ooltewah, Tenn.

SOUTHERN PACIFIC.—Contract has been given by this company to the North American Dredging Co. to fill in a large crescent shape area on the water front of Visitation Bay, which is six miles south of San Francisco. The filling will range from a depth of 3 ft. to 15 ft., and a large amount of yard room will be made available. The water front will be dredged, giving sufficient depth of water for large vessels to land at the wharves that are to be built in connection with the new yards.

STATESBORO & MIDVILLE.—Incorporation has been granted a company under this name in Georgia, with a capital of \$50,000, to build a railroad from Statesboro, in Bulloch County, northwest to a point near Garfield on the Millen & Southwestern, thence to Midville in Burke County, on the Central of Georgia; thence continuing in a northwesterly direction to Louisville, Jefferson County, about 60 miles. The road will pass through a rich agricultural and timber section. Surveys will be started at once. The office of the company will be at Savannah. The incorporators are C. G. Ogburn, J. A. Doyle, R. Meldrin, G. N. Jones and others, of Savannah.

WABASH.—Under the name of the Lorain & West Virginia this company is building an extension from Wellington, Ohio, on the Wheeling & Lake Erie north to Lorain. Contracts have been let to G. M. Kepner, of Connorsville, and to F. J. Petterson, of Cedar Rapids, Iowa. The road will be 20 miles long and the grading will cost about \$1,500,000.

RAILROAD CORPORATION NEWS.

ALTON, GRANITE & ST. LOUIS.—See East St. Louis & Suburban.

BESSEMER & LAKE ERIE.—Gross earnings for the year ended December 31, 1905, were \$5,407,692, an increase of \$1,130,546; net earnings, \$2,758,595, an increase of \$626,062.

CANADIAN PACIFIC.—Gross earnings for the month of February were \$4,224,452, an increase of \$1,168,358.

CHICAGO, ROCK ISLAND & PACIFIC.—This company has sold to Speyer & Co. \$6,000,000 two-year 4½ per cent. collateral notes secured by \$7,500,000 Rock Island, Arkansas & Louisiana bonds. The proceeds of the sale of these notes will be used to meet expenditures made and to be made for the construction of the R. I., A. & L.

COLORADO SOUTHERN, NEW ORLEANS & PACIFIC.—This company has sold to Blair & Co. and the Old Colony Trust Co. \$7,500,000 5 per cent. five year notes secured by \$8,000,000 4½ per cent. bonds, and by the entire capital stock of the C. S., N. O. & P. The proceeds are to pay for the construction of the road.

CRIPPLE CREEK CENTRAL.—The directors have declared the regular quarterly dividend of 1½ per cent. on the \$2,500,000 common stock, and an extra dividend of one-half of 1 per cent.

EAST ST. LOUIS & SUBURBAN (ELECTRIC).—The stockholders of this company and of the Alton, Granite & St. Louis have agreed to consolidate the two companies. The new company will have \$7,000,000 5 per cent. preferred stock cumulative from May 1, 1906, and \$7,000,000 common stock. For each 50,000 shares of stock of the East St. Louis & Suburban, one share of preferred

and one and one-twentieth shares of common stock of the new company will be issued. For each of the 500 shares of preferred stock of the Alton, Granite & St. Louis, one share of preferred and one-fifth of a share of common stock of the new company will be exchanged and half a share of preferred and six-tenths of common of the new company will be exchanged for each of the 21,500 shares of common of the Alton, Granite & St. Louis.

ERIE.—Gross earnings for the month of February were \$3,635,419, an increase of \$922,338.

ILLINOIS CENTRAL TRACTION.—Julius Christensen & Co., Philadelphia, are offering for sale the unsold portion of a block of \$1,300,000 I. C. T. first mortgage 5 per cent. bonds of 1933, principal and interest guaranteed by the Illinois Traction Co. The bonds are secured on 40 miles of interurban road between Decatur, Ill., and Springfield.

INDIANA HARBOR.—See Indiana, Illinois & Iowa.

INDIANA, ILLINOIS & IOWA.—Plans are under way for the consolidation of this company with the Indiana Harbor, the new company to be known as the Chicago, Indiana & Southern, with \$20,000,000 capital. The Lake Shore & Michigan Southern now owns the entire capital stock of the I. I. & I.

NATIONAL OF MEXICO.—Gross earnings for the year ended Dec. 31, 1905, were \$6,377,862, an increase of \$593,238; net earnings, \$2,235,534, an increase of \$303,247. The surplus after charges increased \$340,639. The average mileage operated was 1,713, an increase of 126 miles.

This company has acquired the Hidalgo & Northeastern, a narrow gage railroad, 138 miles long, at a cost of about \$3,100,000.

NEW ORLEANS GREAT NORTHERN.—This company has arranged for trackage rights for five years over the New Orleans & Northeastern tracks from Slidell, Ala., to the outskirts of New Orleans.

NEW YORK, NEW HAVEN & HARTFORD.—This company offers to exchange one share of its capital stock for each \$200 of the 4 per cent. debentures of the Consolidated Railway, of which there are \$7,491,000 outstanding.

This company has sold \$1,500,000 Harlem River & Port Chester 4 per cent. gold bonds of 1954, being part of an authorized issue of \$15,000,000, of which \$7,865,000, are outstanding. The proceeds will be used for six-tracking and other improvements of the Harlem River branch.

The Massachusetts Legislature has passed bills authorizing the Rhode Island & Massachusetts Railroad Company to sell its franchises and property to the N. Y., N. H. & H., and one to authorize the New Haven & Northampton to increase its stock, to issue bonds and to sell its franchise and property to the N. Y., N. H. & H. Both roads have long been controlled by the New Haven.

NORTHERN PACIFIC.—This company and the Great Northern have made an agreement whereby they will use jointly their two parallel single track roads on the east side of the Mississippi running from St. Paul, Minn., northwest to St. Cloud, about 75 miles. This gives each company the advantages of a double-track line.

PENNSYLVANIA.—Gross earnings of the lines east of Pittsburgh and Erie for the month of February were \$10,905,124, an increase of \$2,216,300.

The New York Stock Exchange has listed \$2,980,000 additional capital stock, making the total amount listed \$305,933,300.

PHILADELPHIA & READING.—Gross earnings for the month of February were \$3,253,275, an increase of \$651,072.

SOUTHERN.—Gross earnings for the month of February were \$4,433,002, an increase of \$1,021,151.

TRI-CITY RAILWAY & LIGHT.—This company, which is a consolidation of all the street railway, gas and electric lighting companies of Rock Island, Moline, and East Moline, Ill., and Davenport, Iowa, will have an authorized capital stock of \$12,000,000, of which \$2,600,000 6 per cent. cumulative preferred stock and \$9,000,000 common stock will be issued soon. The funded debt will consist of \$9,000,000 5 per cent. bonds of 1923, redeemable on any interest date at 105 and accrued interest. Of this amount \$464,000 is reserved for the retirement of underlying bonds maturing annually up to 1911, while \$6,000,000 are being offered for sale by Mackay & Co., and N. W. Halsey & Co., of New York. The remainder of the bonds is reserved for additions and improvements.

UNITED RAILWAYS INVESTMENT COMPANY OF SAN FRANCISCO.—The directors have declared a dividend of 4½ per cent. on the \$15,000,000 preferred stock, payable May 1. This dividend includes all the arrears of this stock.

